

Fire from the Sky

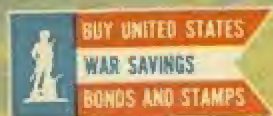


POPULAR MECHANICS MAGAZINE

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SEE PAGE 14





Remember when . . . *your good tires wound up at the old swimmin' hole?*

THAT OLD CASING made a dandy swing, so what if it *did* have a few thousand miles left in it?

The tubes that bobbed so merrily in the water could still hold air. But that didn't matter, either! For in those days, rubber was plentiful.

What wouldn't a lot of us give for those same tires and tubes today! Many of them, no doubt, were almost as good as the ones on which we'll probably have to ride for many long months to come.

The rubber crisis is not over—and until it is over it is squarely up to you to get every possible mile from your present tires. Rule No. 1: *Keep air pressure up to 32 and speed down to 35.* Rule No. 2: *Have your tires recapped as soon as they're smooth.* (Recapping is not rationed.) The rest is

just careful driving and watchful attention.

Making those tires of yours last is more than just a matter of keeping your own car in shape for your own use. It's joining up with other good Americans from coast to coast to help win the great Battle of Rubber—and keep America's wartime transportation rolling until the war is won.

★ ★ ★

Whenever you see a "Seiberling Tire" sign, you can be sure that it marks the establishment of an INDEPENDENT business man—a man who has had the courage and initiative to go into business "on his own"—and thus CREATE JOBS FOR OTHERS. He could do this because, here in America, we believe in "Free Enterprise"; we believe that the greatness of this country in the future, as in the past, must depend in large measure upon the opportunities it offers for the independent business man to grow and prosper. Seiberling Tires always have been and will continue to be sold by INDEPENDENT dealers only!

SEIBERLING *Experts in Rubber*



Wartime manufacturers of Bullet-Sealed Tubes and Military Tires for our armed forces • Bullet-Sealing Gasoline Tanks • Rubber Floats, Boats and Pontons • Rubber Parts for Gas Masks, Airplanes and Tanks. Also makers of Tires and Tubes for passenger cars and trucks • Sealed Air Tubes • Rubber Heels, Soles and Mechanical Goods.



MEET YOUR NEW NEIGHBOR . . .

Holland is a tiny nation, proud and independent. In time of peace, it was thought of as a land of dikes and windmills, of tulip beds and pleasant, industrious people. . . . But, there will be much to learn about Holland, its love for freedom and its implacable fight against tyranny and oppression . . . There will be much to learn about every nation of our world, important things for understanding and tolerance that will mean a better peace. . . . One of the finest means of studying our World Neighbors is shortwave radio. With it, you can reach any nation almost instantaneously to know the history and politics of that nation even while they are happening. . . . Look to Hallicrafters, when Peace is won, for the world's best short wave receivers—the results of over fifty million dollars worth of war research and developments in Radio.



HALLICRAFTERS RADIOS are the Radioman's Radio. Designed and built for experts, they are the world's finest shortwave receivers. Victorious Allied Armies all over the world will attest to their excellence. **THE HALLICRAFTERS COMPANY, CHICAGO 16, ILLINOIS, U. S. A.**

BUY A WAR BOND TODAY!

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This One



HN4G-UHE-XA7D

AUGUST, 1944

1A



Bearing up well

He's carrying quite a load but he's doing all right. And he's mighty grateful for your help—especially when Long Distance circuits are crowded.

Then the Long Distance operator may say — “Please limit your call to 5 minutes.” Saving telephone time is important in wartime.

BELL TELEPHONE SYSTEM



Popular Mechanics Magazine

Registered in U. S. Patent Office and Canada

H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

August, 1944

Vol. 82, No. 2

Next Month

MATA HARI of this war is the photo-reconnaissance pilot, stealing Jap and Nazi military secrets from the air at 300 miles an hour—and more. It was "rec" that found the battleship Tirpitz in a Norwegian fiord, that spotted the 200 Jap planes ready for harvest at Wewak and spied out the German radio-location factory in the old Zeppelin works at Friedrichshaven. "Picking the Target," a feature in the September issue, tells the role of the flying spies in mapping France for the Invasion Command and grabbing closeups of the beaches from 300 feet above the Nazi coastal batteries.

500 Trains a Day

THE towermen in the Pennsylvania Railroad's "Union Tower" at Rahway, N. J., have gallery seats looking down on the busiest traffic thoroughfare on any railroad. Five hundred trains a day highball past this point on their way into and out of New York, and there are moments when all six electrified tracks are loaded and the operator is plenty busy logging engine numbers. Pay a visit to this tower—read "Highballing 500 Trains a Day" in the next issue.

Rescue From the Sky

MAROONED at a trading post 400 miles north of the Arctic Circle, four white persons and 50 Eskimos faced starvation. Ice had stopped their supply ship; the U. S. Army Air Force was their last hope. Help came quickly—a ton of supplies parachuting out of the sky, then a rescue plane. A September story tells of this new Emergency Rescue service.

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Power for Our Western Empire

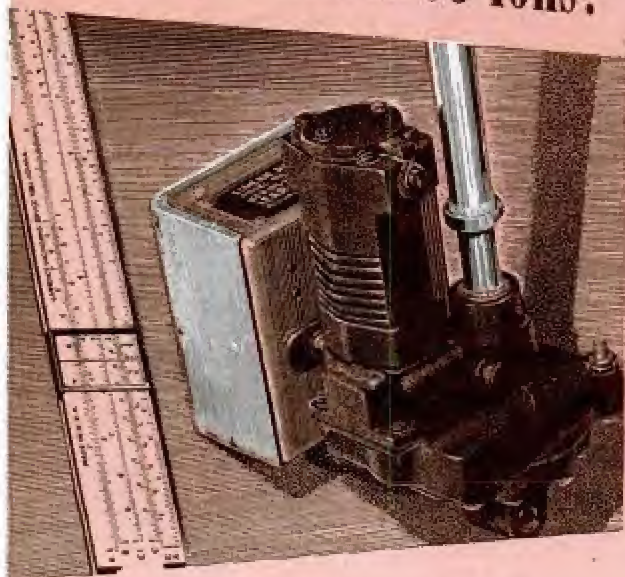
THERE is a vast empire coming into being—an empire of 20 million acres that will be ripe for development when G. I. Joe comes home in search of a career. The basis of that empire is power: networks of electric lines from Boulder Dam and Grand Coulee, Shasta and others to power new industries across the west. Power, too, in irrigation: the Department of the Interior proposes to turn 16 million acres of desert into 150,000 productive farms in the three years after the war. A feature in the September issue introduces you to America's coming empire.

Heroes of the Tin Cans

THE life of a destroyer in battle is figured at just 11 minutes. Some live longer. The U.S.S. O'Bannon won a Presidential Citation for an epic career culminating in a battle off Vella Lavella, where the O'Bannon and two other destroyers fought nine Jap ships for 30 terrible minutes, sank three and routed the rest. Follow the Yankee destroyers into battle around the world—read the story of the "Heroes of the Tin Cans" in next month's issue.

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Want to move 35 Tons?



WE wouldn't tell you how fast America's fighting planes go. That's a military secret.

But we've all read it's well over 300 miles an hour.

We've read too how they hit 700 or 800 miles an hour in dives. And how paint was peeled by the air pressure.

Did you ever stop to think that the plane's flaps and controls have to work surely, smoothly and dependably against pressures like that?

It's done by such mechanisms as you see in the picture.

They are called Lear Actuators.

They are powerful. Some can push up to 75,000 pounds.

They are light. That's a "must" in aircraft.

They are small. They have to fit in available space.

A good many preconceived notions had to go by the board to meet all these requirements. For example, the little electric motor that runs them is full of revolutionary engineering refinements.

Every man and every minute we have now can't make all the motors and actuators that we would like to deliver for Uncle Sam's aircraft.

But the day is coming when they will have different jobs to do. New jobs on peacetime products—perhaps like steering ocean liners, or parking cars, or things we've never thought of.

That is one reason for this advertisement. We want to know who can use an actuator or a motor like these.

Another reason is, we want you to know that there is available the kind of thinking and engineering which have produced these and some 250 other Lear products.



Ingenious New Technical Methods

Presented in the hope that they will
prove interesting and useful to you.

**HAND
GROUND**



**MACHINE
GROUND**



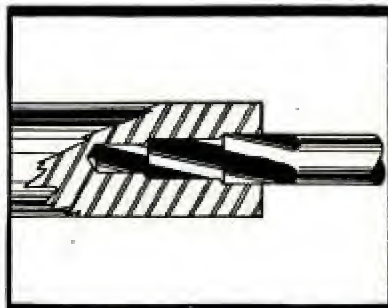
New Precision Step Drill Grinder Simplifies Production and Maintenance of Step Drills

The quality of a step drill produced by common methods depends almost entirely on the skill and attention of the individual tool maker. However, with the development of the precision step drill grinder, the human element has been entirely eliminated, the characteristics of the step being completely controlled by the grinding machine without adjustments during the course of grinding. This automatic feature insures absolute uniformity, regardless of quantity, and permits large-volume production of step drills.

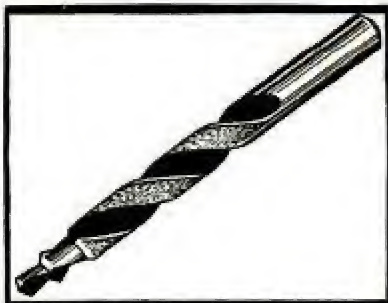
The apparent advantages gained through the use of the step drill grinder are: Permits mass production of drills ground to exact specifications, entirely independent of the human element. Maintenance, too, is no longer an obstacle as step drills produced by this method are quickly sharpened by the same uniform machine-controlled operation. With the step drill grinder step drills can now be made from standard drills. These advantages result in a wider application of step drills which provide a definite saving of machine tools, man-hours and cost; this in turn results in greater production.

You know there are plenty of benefits in chewing gum, too. That's why all of the Wrigley's Spearmint we're able to make from our available stocks is going overseas to our fighting men and women. You know what a lift it's been on the job and we wish we could supply everybody, because we have pride, too, in our workmanship and productivity. But there just aren't enough available top quality raw materials right now to do it. When we can produce it in sufficient quantity, it will be back to you with the same fine flavor and chewing satisfaction... Wrigley's Spearmint has never been changed!

*You can get complete information from Spiral Mfg.
Corp., 5022 North Kedzie Avenue, Chicago 25, Illinois.*



The above illustration shows mechanical design which requires a hole having diameters diminishing in steps. This is an operation for step drills which has often been neglected due to difficulty in obtaining and maintaining step drills.



Step drills produced by our method are quickly sharpened by the same uniform, machine-controlled method.

Y-128



When lint collects upon a suit,
Or threads on dresses stick,
Some Texcel Tape—rolled inside out—
Will pick it off—but quick!

And when this calendar was hung
No hole was left to gape,
For neither nail nor tack was used.
What was? Why, Texcel Tape!



So many things about a house
This Texcel Tape can do—
From wrapping up to fastening down
In place of strings or glue.



For Texcel is an improved tape
Whose "stick-um's" bonded on.
It won't come off, it won't dry out
Before the judgment dawn.

Since all the Texcel Tape that's made
Is being used for war,
Buy Bonds and Stamps 'til Victory
Returns it to your store.



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Industrial Tape Corporation
A Division of
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New Brunswick, N.J.

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YES, Mr. (or Miss) Bookkeeper, you can become an accountant and make real money.

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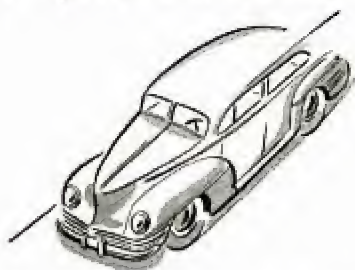
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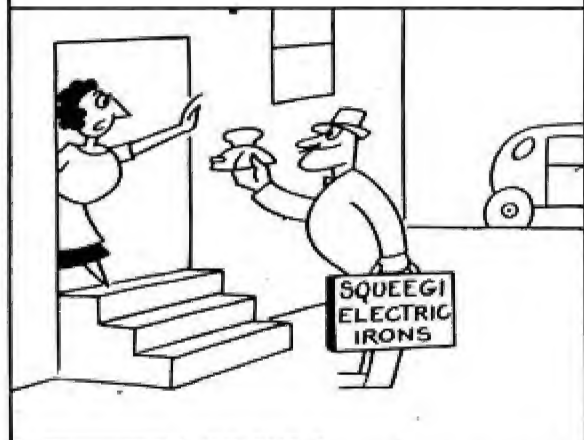
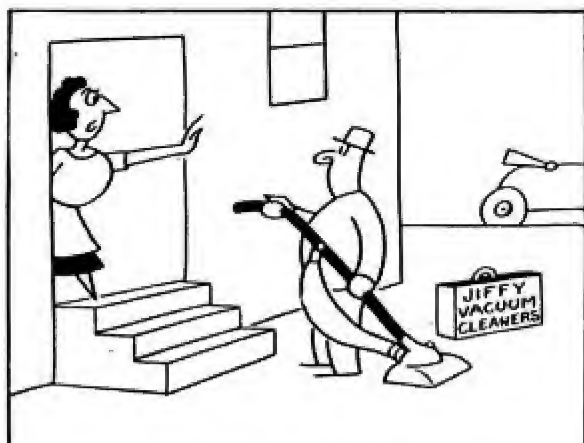
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O. SOGLOW

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It is the intention of this magazine to provide its readers with information regarding the latest developments in the mechanical arts. We take no responsibility as to whether the disclosures contained in our articles are covered by patents and advise readers to investigate this subject before making, using, or selling any of the products, machines, or processes described in order to avoid possible liability for patent infringement.

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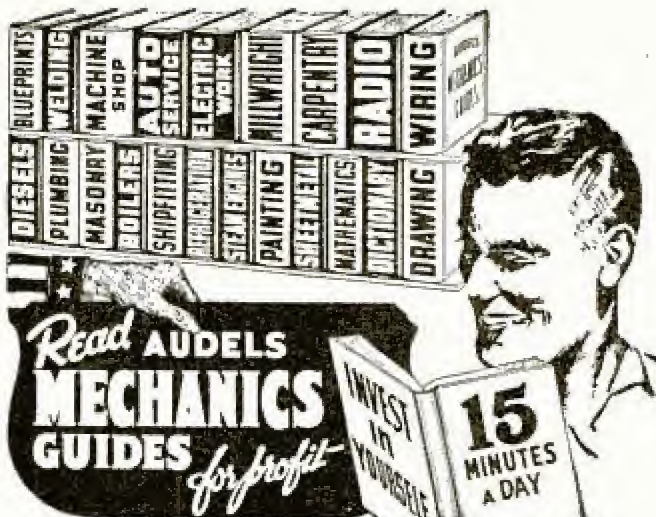
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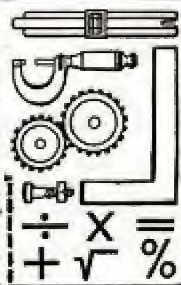
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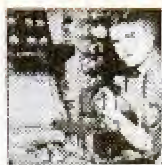
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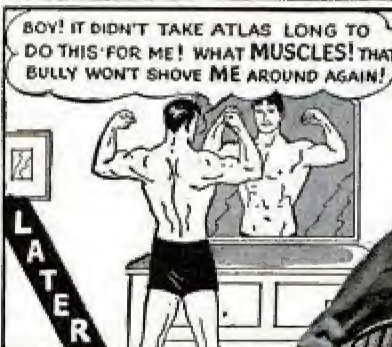
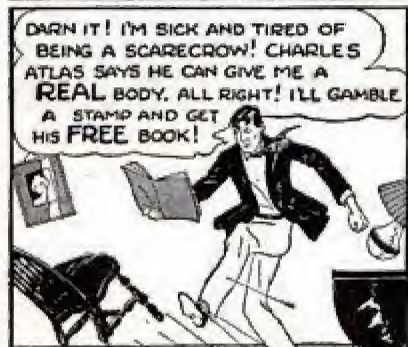
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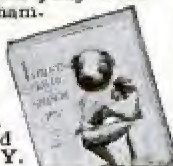
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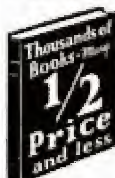
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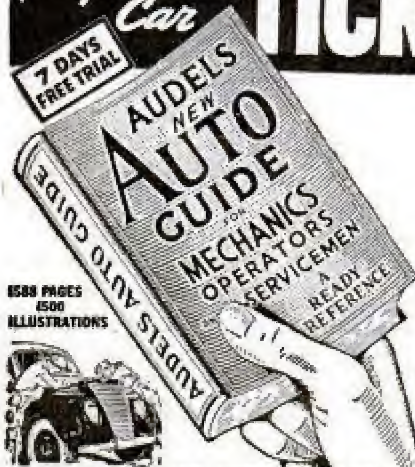
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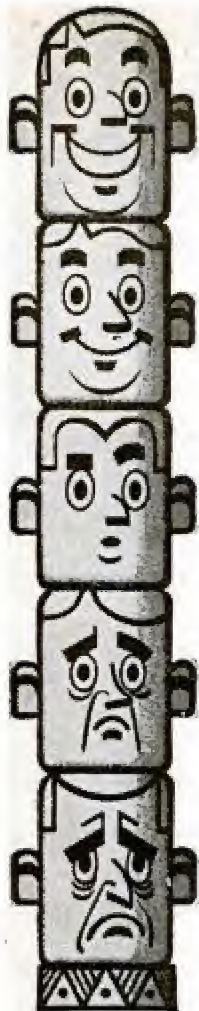


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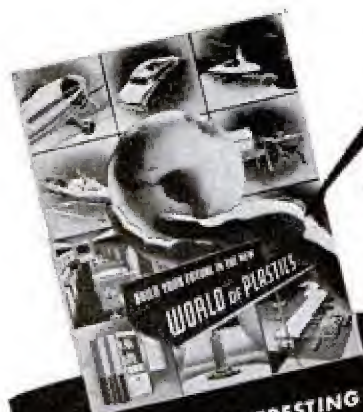
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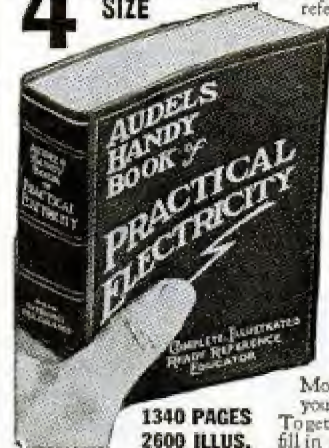
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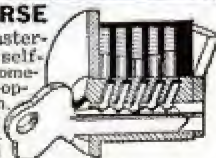
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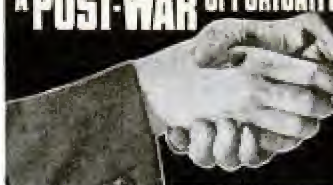
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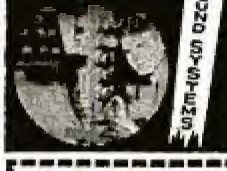
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 ADDRESS.....
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INSPECTION PROBLEMS?

Here's how Controlled Lighting saves time on tough inspection jobs



G-E REFLECTOR LAMP

REFLECTING MIRROR

To look inside a 75 mm. shell was difficult...until G-E lighting engineers helped work out a faster, more accurate inspection method. A standard G-E reflector lamp with a mirror arrangement "turns shells inside out"—makes sure there's no grease, dirt or pitting. It's a typical example of inspection methods that use controlled lighting...and it's another instance where G-E engineers have helped to gain faster, better inspection methods.



1 Brightness contrast patterns are useful for the inspection of chatter in polished metallic surfaces. Reflections reveal defects of unevenness and other irregularities.



2 An inspection unit developed specifically for cartridge case inspection. It makes use of reflected light from mirrors, showing the interior and primer cup end of the cases.



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0323

Vol. 82

AUGUST, 1944

No. 2

HOW THE INVASION WAS PLANNED



Signal Corps photo
U. S. assault troops with
full packs wade through
gap in Nazi's West Wall

Mr. Whitaker

IN SPEAKING of the greatest military assault in history—the invasion of France by the Allied forces—Prime Minister Churchill said:

“Everything proceeded according to plan. And what a plan!”

The magnitude of that plan, worked out by persons Herr Hitler once called “military idiots,” staggers the imagination. It embraced the air, ground and sea forces of this nation and our allies. It hurdled problems of supply and transport, of pre-invasion training, of production and improvement of weapons, of photo-reconnaissance and mapping on a scale that makes the battle plans of Napoleon look like a game of checkers. More than 125,000,000 maps alone, just to mention one item, were used in perfecting the master invasion plan.

The success of that plan was demonstrat-

ed to a stunned enemy and a surprised world on D-Day. Four thousand ships carried the magnificently equipped troops across the English Channel under protection of a powerful naval force including 12 battleships, and thousands of aircraft.

Parachute and airborne divisions, spearheading the invasion, filled the sky over Normandy. As a climax to the “combined operations” attack on German coastal defenses, Allied planes dropped 11,000 tons of bombs in the eight hours preceding the landing and big naval guns pounded the coast before the troops went ashore. In 10

AUGUST, 1944

*Hartup Aircraft, Inc.
Lanthorne, Calif.*

1



Beachhead on D-Day—troops in ducks, half-tracks and afoot advance on German positions. Note file on hill

minutes, 600 naval guns fired 2,000 tons of shells at Nazi batteries.

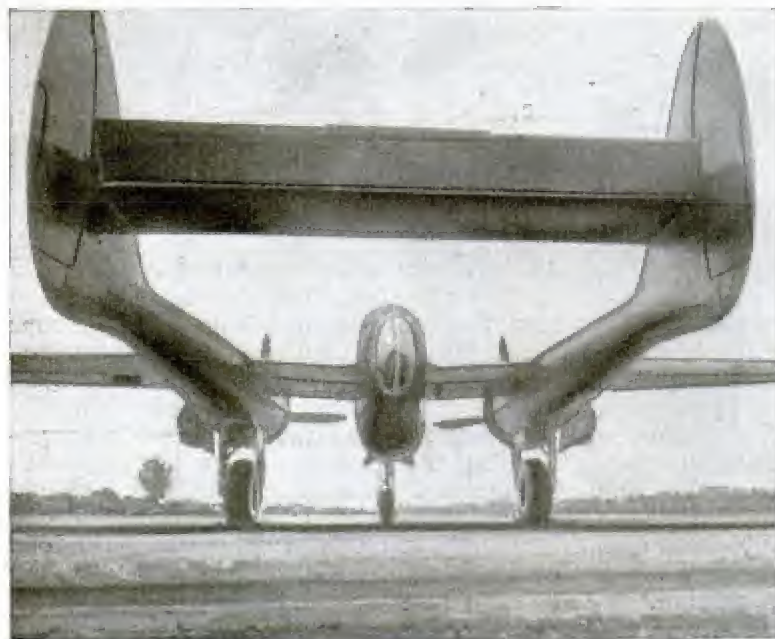
Behind the invasion plan were lessons learned the hard way on the beaches of Dunkirk, Dieppe, North Africa, Sicily, Salerno, Anzio, Attu and Kwajalein.

After the general timing for the invasion was set at Teheran, the exact site for the landing was decided upon. This remained a closely guarded secret until H-Hour on D-Day. The low sandy beaches of Normandy between Le Havre and Cherbourg

were selected not only for their proximity to great bases and supply depots in England, but because the region was suitable for amphibious operations and the defenses were within easy range of our aircraft.

The Norman coast, however, was just about the center of Hitler's famous West Wall. German boasts about the invulnerability of this West Wall acted as a boomerang, for they inspired the most careful reconnaissance in military history.

What happened to this



P-61 night fighter "Black Widow," was among the new weapons ready for the invasion push



Yanks crowd a Navy LCI as craft nears invasion coast. Below, firing eight-inch siege gun with 18-mile range

West Wall on D-Day? The answer forms a revealing chapter in the invasion plan. For months our troops had been storming a replica of that West Wall set up along the coast of England.

From information obtained from Commando and Ranger raids on the French coast, from the French underground, from photo-reconnaissance, from scouting parties in small boats and midget submarines came a complete picture of German coastal defenses. The only thing missing was the secret rocket weapon which the Nazis threatened would blow England to bits.

The Nazi shore defenses consisted of a ring of tubular steel scaffolding built under water 150 yards out from the high



Amphibious "ducks" practicing invasion maneuvers





Barrage balloons over invasion armada add to aerial cover; top, studying captured Nazi layout of beach

water line, and behind this a double apron of wire fence, concrete antitank barriers in zigzag arrangement with protruding steel prongs (called "horned scullies" by our troops), and another double apron of wire fence. On the beach above the high water line was a three-foot barbed wire fence, a mine field, an intricate deep wire obstacle, an antitank ditch, concrete antitank wall, and "dragon's teeth"—concrete blocks to stop tanks. Behind this maze of beach de-

fenses were pillboxes; farther back, heavy artillery. With the mined waters off shore—which were cleared by minesweepers during the early hours of D-Day—this composed the coastal sector of Hitler's West Wall.

A duplicate of these defenses was built by American and Royal engineers at a pre-invasion training base. When the assault divisions of engineers and infantry arrived in the first landing barges, they knew how

U. S. cruiser Augusta nearing rifle range of French coast dwarfs landing boats carrying assault troops



to blast a gap through these barriers. After the engineers had cleared a path for the assault infantry to advance on the pillboxes, the first heavy equipment to come ashore was the bulldozers.

These bulldozers with armored cabs roll off the barges pulling sleds with steel mats to build roads across the soft sand. If a tank or piece of heavy artillery is hit by an enemy shell, or a truck bogs down, the bulldozers push them out of the way and the supplies move on. Some of the bulldozers



With hands lifted in surrender, Nazis come over crest of hill in France



Troops firing behind enemy beach obstacles at Nazi pillboxes. Below, abandoned German robot tank found in a dugout near the shore; remotely-controlled tank is loaded with explosives



were carried ashore from LST's and other landing craft on the Navy's new "Rhino Ferry," a self-propelled barge of light welded steel pontoons. These pontoons, one of scores of innovations developed for the invasion, can also be put together to form floating wharves and causeways.

Airborne divisions were used on a scale that dwarfed the German landings at Crete and our own in Sicily. An airborne division is made up of a regiment of paratroop infantry, two glider regiments and miscellaneous units, such as engineers, quartermaster, signal corps, medical and others. One paratroop innovation in Normandy was the dropping of dummies which confused the Germans as to where the real landings were to be made. Adding injury to in-



Tank destroyer affords shelter from snipers at Normandy beach on D-Day

sult, some of the dummies were filled with explosives.

The spearheading paratroopers, all with particular jobs to perform and special targets to attack, cleared strips for the "one-mission" gliders to land men and equipment. Some gliders carried light tanks. The glider regiments quickly built landing strips for the troop transports. The location of these airstrips was selected months in advance from aerial photos. The calculations from these photos are so accurate that the number of cubic yards of earth to be moved can be closely estimated. This careful planning was one reason five airstrips were completed a few days after D-Day. This was an important factor in the rapid advance and the joining up of airborne and seaborne infantry to consolidate

ers and 500 bombers to combat the 7,500 Allied planes operating with the invasion forces. The plan worked so well that the weakened Luftwaffe left the sky to the Allies on D-Day.

The air attack wound up with a 50-day assault on enemy transportation extending several hundred miles inland from Holland to the Bay of Biscay. Ninth Air Force fighter bombers and rocket-firing R.A.F. Typhoon fighters threw enemy transportation and communications into chaos. American Mustangs, Lightnings and Thunderbolts added "strafe bombing" and "glide bombing" to the familiar technique of dive bombing. In strafe bombing, the fighters come in low and plant delayed-action bombs before pulling up to almost 90 degrees. In glide bombing, the angle of de-

positions along 60 miles
of coast.

While troops were training and great piles of material were accumulating in England, our air fleets were carrying out a plan for strategic bombing of enemy targets. On their "priority" list were submarine pens, aircraft, munitions and armament plants, oil refineries, synthetic rubber factories and all industries producing goods for the Nazi machine. The Luftwaffe's wings were pinned back in the air and on the ground, according to plan. The result was that on D-Day Allied Supreme Headquarters could estimate the Germans had a maximum of 1,750 fight-

U. S. airborne troops, spearheading invasion forces, leap from glider after landing behind enemy lines



scent is more gradual than in dive bombing and the ascent much sharper. At 400 to 500 miles an hour, the planes are too fast to be tracked by Nazi flak batteries.

The region around Caen was marked on the master invasion plan as the focal point for pre-invasion bombing, but care had to be taken not to tip our hand in advance of D-Day. Twenty-one days before D-Day airfields and communication centers were bombed within 130 miles of Caen.

The next step was a concentrated assault on coastal batteries, set in 30 inches of concrete, along the invasion site. This attack was carried out on the eve of D-Day and repeated 30 minutes before H-Hour. Night and day fighters were used, in the final assault joined by 1,350 Flying Fortresses and Liberators. The 11,000 tons of bombs mentioned earlier, were dropped in this final phase.

During the actual landing, fighters covered every beach operation. American Thunderbolts flew high cover, British Spitfires flew low. Night bombers laid smoke screens. Other planes protected the convoy across 70 miles of channel.

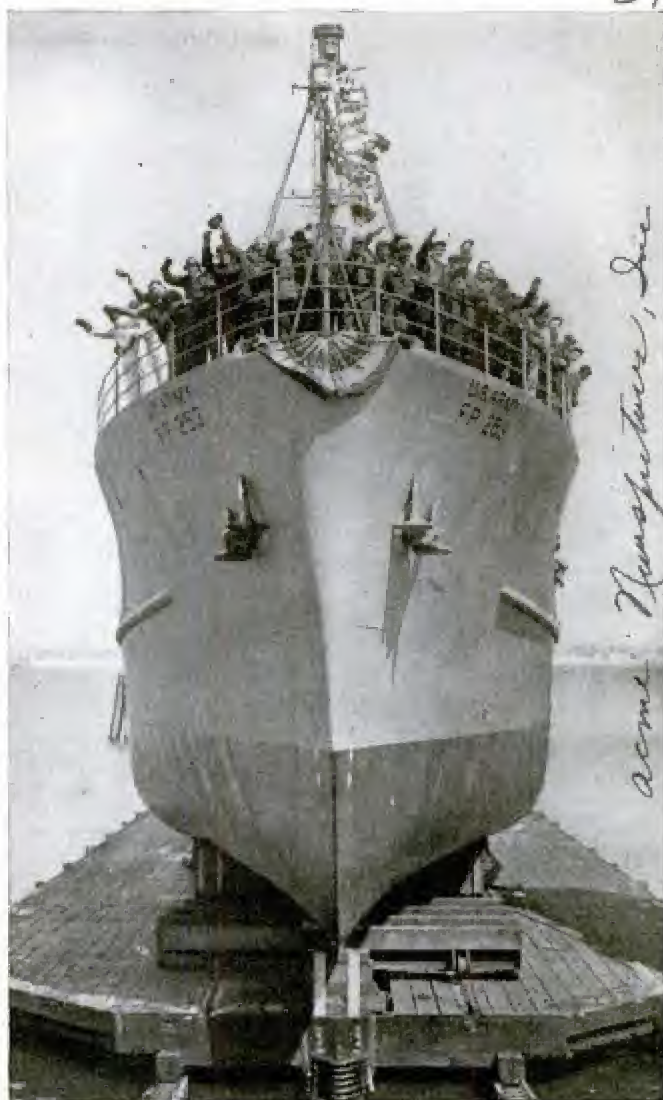
One of the greatest problems for the invasion planners was the shipping of gigantic stores of fighting equipment and supplies to England, assembling the equipment and distributing it to coastal depots. Every one of the thousands of men landed in France required about 10 ship tons of overall equipment, and an additional ship ton every 30 days. The number of separate items needed was about a million. Some of these million items had to be accumulated in millions, resulting in astronomical totals. These supplies, ranging from M-4 tanks, 240-mm. howitzers and flame throwers, to bazookas, razor blades, and carrier pigeon feed, were moved by ships on a rigid timetable.

For two years these supplies flowed steadily to depots scattered over England. The Army Service units—ordnance, engineers, signal, medical, transportation, quartermaster and others—built up stock piles so large there was no chance of putting many under cover. Fields were blanketed with guns, rocket weapons, amphibious vehicles such as the famous "duck," trucks, half tracks, bulldozers, ambulances. The only protection from enemy eyes at these open-air depots was camouflage and the

Continued to page 160

Sliding Platform to Launch Ship Is Floated Out From Under

0190



acme. Transportation, Inc.

Among wartime innovations for ushering a ship from the ways to the waves is a sliding platform which holds the craft erect. The platform, used recently to launch a vessel built for the Army Transportation Corps, is released by cables. After ship and platform are in the water, the latter is floated out from under the vessel.

Fighter Plane Gets Steel Teeth For "Buzz Saw" Attack

0217

Fighter pilots could literally bite off the wings, tails and other exposed parts of enemy planes in combat with a recently patented sawtooth blade. The inventors proposed to line the saw with sharp steel teeth and attach it beneath the fuselage. The blade is hinged at the forward end and is retractable.

Boeing Aircraft Co.
Seattle, Wash.



By **Wayne Whittaker**

AFTER several years of suspense the "wraps" are off the most whispered about bomber in the world and America's ex-military secret No. 1.

The job of keeping a veil of secrecy around the Boeing Aircraft Company's Superfortress, the B-29, might be compared with trying to hide Vesuvius under a circus tent. Recently, the giant four-engined ship, half again as large as a Flying Fortress, opened a new chapter in aerial warfare with the bombing of The Imperial Iron and Steel Works at Yawata.

The B-29 can fly higher, faster, farther, and carry a heavier bomb load than any

Beside Boeing's B-29, target plane (Culver Kaydet) looks like a model

POPULAR MECHANICS

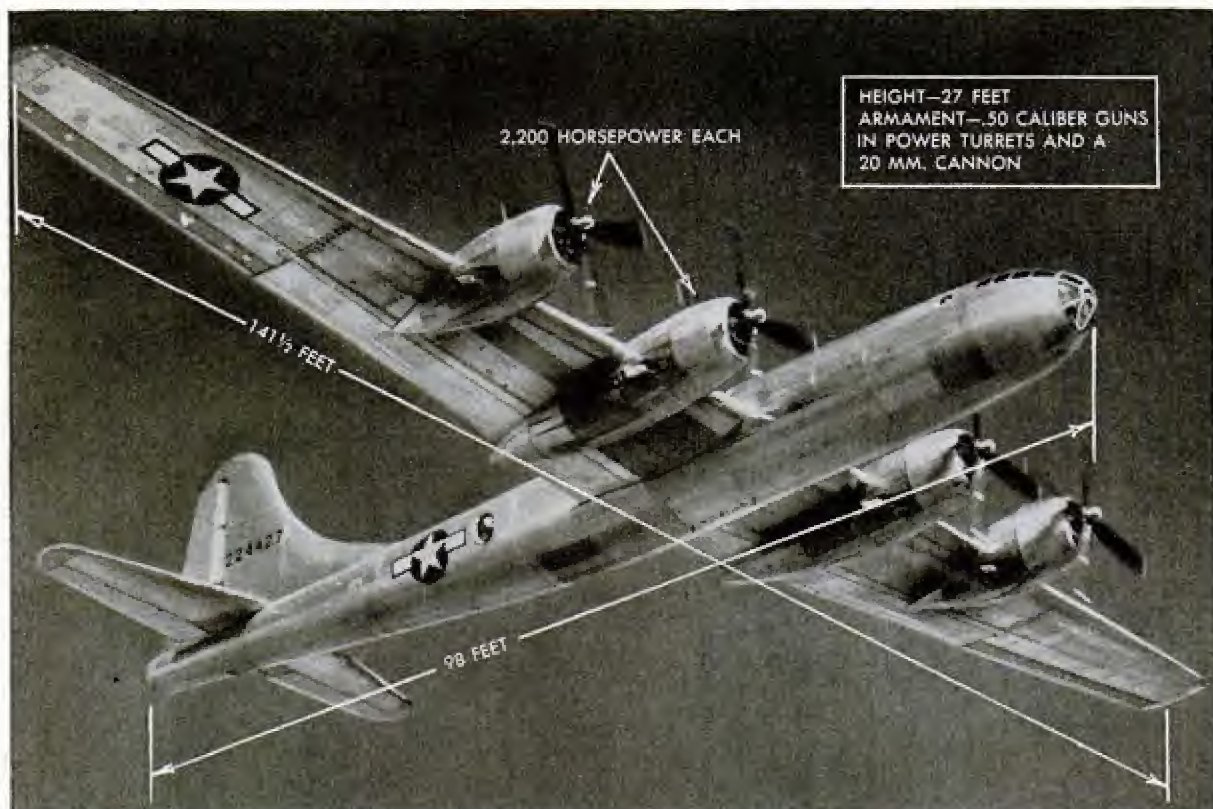


Long-nosed queen of the AAF has the greatest range and bomb load, and can fly higher than any other bomber. Below, tail resembles B-17

other bomber in the world. It can blast enemy fighters out of the sky with a 20-mm. cannon and .50-caliber machine guns in power turrets.

This super bomber, destined to become a familiar sight over enemy territory, is still a stranger to most Americans. Outwardly, except for size and elongated nose,





Wings appear to be attached almost at center of fuselage; machine guns and cannon have been airbrushed out

it resembles a Flying Fortress. The nose section, a distinctive feature, projects so far ahead of the wings they appear to be almost at the center of the fuselage. Makers of the B-29 stress that this is an entirely new plane, not an improved model of the Flying Fortress as the name, Superfor-

tress, might imply. It's in a class by itself.

The best way to make the acquaintance of any plane is to go up in it, so let's visit the Wichita plant and go for a test flight on the B-29.

After signing the Army waivers, you go to the flight service shop to be fitted for a

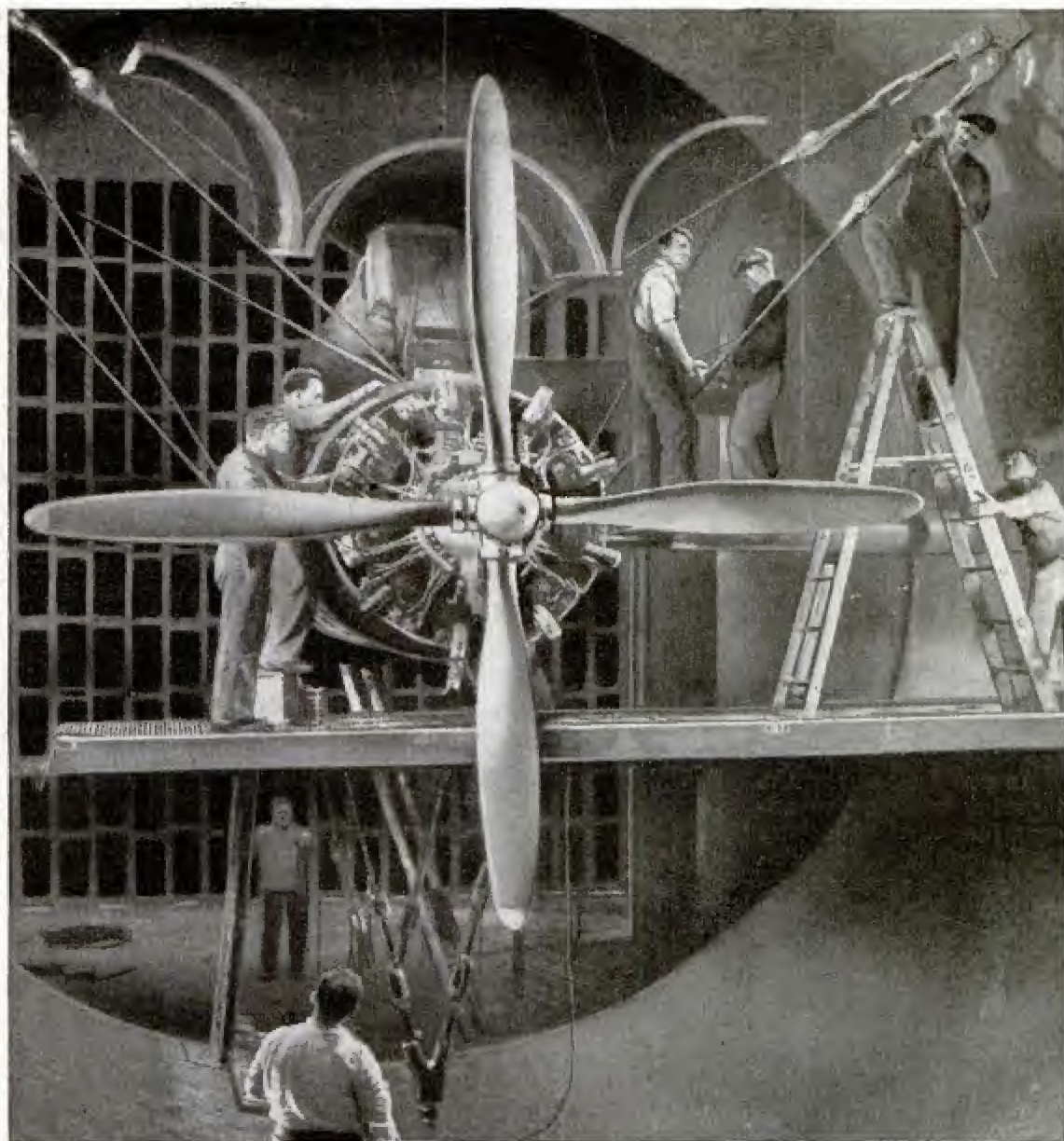
Excellent visibility for gunners is provided at the sighting positions



parachute and receive instructions on how to pull a rip cord. Then you follow the crew to the flight line and crawl up a ladder to a hatch in the forward compartment. You and your parachute sit down at the radio operator's station and the pilot hands you a headset which you plug in on the interphone. The test crew consists of pilot, co-pilot, flight engineer, and an observer in the rear.

The whistling and bop-bop of the interphone is soon interrupted with a voice saying: "Testing . . . testing." Then, after an interval: "All clear."

The four 2,200-horsepower Wright air-cooled engines are started. The plane taxis down the run-



Testing the B-29's 2,200 horsepower Wright engine in Dodge Chicago plant which is turning out thousands

way and swings about. You follow the takeoff on the interphone.

"Wing flaps are 25 degrees . . . engineer to co-pilot over . . . like to make a quick check of the plugs before we take off . . . Roger . . . engineer to co-pilot over . . . will we take off with full turbo . . . yeah, pretty hot day . . . engineer ready for takeoff . . . observer ready in the rear."

The plane moves forward with a surge of power, and as you peer ahead through the bombardier's bay the runway leaps toward you. Then, on the interphone:

"Right gears are up . . . left gears are up . . . everything normal at the engineer's stand . . . cut the putt-putt."

The "putt-putt" is an auxiliary power plant which supplies power to operate the

brakes and flaps when taxiing, taking off or landing.

The bomber, which weighs perhaps twice as much as the 30-ton Flying Fortress, is off the ground in a jiffy and seems to climb with the ease of a fighter plane.

You climb up in the navigator's seat and view the plane and the world below from the bubble where he "shoots" the sun. The Superfortress has a wing span of more than 141 feet and is nearly 100 feet long. Overall height is more than 27 feet. In comparison, the Flying Fortress has a wing span of 103 feet, a length of 75 feet, and height of 19 feet. The 16½-foot four-bladed propellers of the B-29 are the largest ever installed on any aircraft, and the 8,800 horsepower of the engines is nearly twice that of a B-17.



Superfortress (B-29) is half again as large as Flying Fortress (B-17). Below, mechanic on wing of superbomber grooms 2,200 horses for sky ride

straddle the automatic pilot, and look down through the crystal-clear nose to the peaceful farms of Kansas. You try to imagine the bombardier's sensation with an enemy fighter rushing in headon with guns blazing, or in the face of enemy flak. Then you climb up by the pilot and crouch on the hatch cover. The cold metal testifies the air outside is plenty cold.

E. M. "Allie" Allison, chief test pilot for Boeing, says the plane "flies like a dream."

The cruising speed, maximum speed, ceiling, range, placement of armament and number of guns, and bomb load, are still military secrets. Everything about this "perfect" bomber has been dictated by lessons

As you look out at the tapering wings, you accept the word of Boeing engineers that the Superfortress is aerodynamically the "cleanest" large plane ever designed. The wing, which is completely new, has an ingenious flap to reduce the speed of landings and distance of takeoffs. This gives the B-29 the same landing speed as a B-17. The flaps are extended 25 degrees at takeoff, rolling back and down to increase the wing area by 19 percent.

The B-29 is almost entirely electrically operated. Every piece of equipment with the exception of the hydraulic braking system is activated either by an electric motor or cables; there are 150 electric motors on the ship. The control surfaces are "directly" operated by the pilot, which is said to make the plane handle more like a pursuit ship than a bomber.

You move forward to the bombardier's seat,



learned in combat. The Air Force sets the speed at "well over 300 miles an hour," ceiling at "well over 30,000 feet," the range "very long" and the bomb load "very heavy." The range for ferrying the B-29's is greatly increased with auxiliary tanks.

Some conception of the plane's capabilities may be gleaned from the announced fact that it will fly higher, farther and with greater bomb load than any other bomber. It is common knowledge that B-17's have operated above 40,000 feet; that the B-17 with bomb racks under the wings will carry some 10 tons of explosives, and that it can fly from England to Berlin and back.

Test Pilot Allison suddenly reveals that the plane you are on has only been off the ground once before, and then for only 35 minutes.

"But we were pretty sure it would hold together," he says. "We've really tested these babies."

And he isn't kidding. No plane in history has received the tests given the B-29 which made its first flight Sept. 21, 1942. The supercharger for the engines, alone, required more than 5,000 hours of tests. No single supercharger had enough capacity to supply the 18-cylinder radial engines. The result is a twin installation. The plane's great weight also necessitated development of the first dual nose wheel for its "tricycle" landing gear. The aerodynamic perfection of the retracting gear is indicated by the fact that when the gear is down the drag on the ship is doubled.

Five huge plants taking part in the mass production of the Superfortresses include the Boeing factories in Seattle, Renton, Wash., and Wichita; the Glenn L. Martin plant in Omaha, Neb., and the Bell Aircraft Company plant in Marietta, Ga. The Fisher Body Division of General Motors will play a major part in turning out sub-assemblies. The engines are built by the Wright Aeronautical Corporation and the Dodge division of the Chrysler Corporation.

You clap your headset on for the landing. "Observer to engineer . . . how about getting putt-putt started . . . Roger . . . right landing gear down . . . left landing gear down . . . wing flaps are 25 degrees . . . fuel boost is off . . . engineer ready for landing . . . wing flaps are full down."

And the biggest bomber in the world comes in for a perfect landing. The full story of the B-29, which cannot be told yet, will be written across enemy skies. But you can take the word of Gen. H. H. Arnold, commander of the U. S. Army Air Forces, that the B-29 is "superb."

AUGUST; 1944

Basket Built Inside Stroller For Shopping Trips

By using a combination stroller and market basket, a mother in San Francisco solved the problem of how to shop while keeping track of small children. The vehicle is a pushcart which has seats for two children installed



in front of a large built-in compartment for carrying parcels. It is narrow enough to travel in store lanes and includes a safety belt for keeping the children in their seats. The cart weighs only 16 pounds but can load 300 pounds.

Synthetic Rubber Gets New Life From Reclaim Formula

Millions of pounds of used tires, tubes, treads, motor supports and other articles made of synthetic rubber are being salvaged as the result of the discovery of a reclamation formula by United States Rubber Company research men. Scientists had been searching for the method ever since they found that the reclaim formula for natural rubber failed to make the synthetic material plastic enough for re-use. The processing is being done on the same machinery which was used to reclaim natural rubber and the reclaimed synthetic material is converted back into the same items for which it was originally made.

*Rockefeller Center
N. Y., N. Y.*

*Capt. Edw. W. McNeil, Air Corps,
 Laurinburg-Maxton Army Air Base,*

GLIDER PARADE



At start of mission men rush to gliders with equipment, while tow truck crew (foreground) gets ready to pull ships behind tow planes



Flying low, a C-47 drops hook which grabs nylon tow rope. It gradually tautens and jerks glider into the air. The Air Force has shown that three transports in formation can snatch three gliders aloft simultaneously

Below is the double tow arrangement. One glider flies slightly higher and to the rear of the other, preventing collisions in the air. Gliders can carry 75 mm. howitzers, 37 mm. anti-tank guns and tractors to tow them





Above, C-54 transport hauls a CG-13 glider. Great, weird-looking glider fleets flew more than 30,000 miles in April in the day and night invasion rehearsal. In the second day of the real invasion, a 50-mile-long train of gliders crossed into France



Above, gliders descend in "follow-the-leader" style and park compactly



Left, as soon as glider lands men go into action. Some set out on foot, others roll a jeep through the nose



Below, glider occupants board raft as others tie buoys under the wings

Lost Radium Found in Hour By Electric Detector



teur and professional inventors alike to get busy. Here are a few of the needs: A life vest that will inflate automatically and turn the man on his back when thrown overboard unconscious by concussion. An optical method of distinguishing between artificial and natural green. A simple gauge for measuring positive and negative phases of explosion blast. Some way to control fires in tanks until personnel can be evacuated. A quickly erected tramway for unloading ships. Protection against flame throwers. A lightweight, inexpensive material other than synthetic rubber which will hold air or carbon dioxide. Methods of removing or destroying obstacles to landing operations. A way to reduce glare from glass surfaces by durable coatings applicable in the field. Protection against land mines for vehicles. Clothing that will guard against white phosphorus. Methods of generating and dissipating fogs. Location and destruction of hidden pillboxes. A gas mask with a transmitter that will carry the wearer's voice clearly. Colored smokes and odorless toxic agents.

While many of these are beyond the capacity of the amateur inventor, thousands of simpler ideas—whether they apply to war problems or not—are wanted urgently by the National Inventors Council.

Clamp Speeds Planing or Sawing With Firm Grip on Board

Taking the "jitter" out of a board being planed or sawed is the job of a metal U-shaped clamp that can be screwed to work bench or plank. Thumbscrews hold the board firmly in place and a sheet metal guard protects the wood. When planing, two thumbscrews hold the board and a third acts as a stop to prevent it from sliding under pressure. The clamp is also handy for sharpening saws. The saw is placed between two thin boards and put into the clamp.



Operated on much the same principle as a mine detector used by sappers at the front, an instrument to recover priceless capsules of radium has been developed by the General Electric X-Ray Corporation. The detector is connected with earphones, and the location of radium is revealed by a sound like radio static. Recently, the instrument located a stolen \$10,000 radium capsule beneath a bench in a locker room of a Buffalo factory in less than an hour.

Here's List of Inventions Needed To Help Uncle Sam Fight

There's still a vast amount of unfinished business for inventors who want to help win an American victory. How valuable Yankee inventiveness has proved thus far is evident in the long list of weapons and devices turned over to the military services by the National Inventors Council—among them the bazooka's electric firing device, a method of hauling tanks out of ditches, a signaling mirror for lost aviators, multiple uses of milkweed floss.

Now the Council is posing another long list of inventions wanted, and asking ama-

Dept. of Commerce
Washington, D.C.

Helicopter Alights on Sea to "Rescue" Aviator

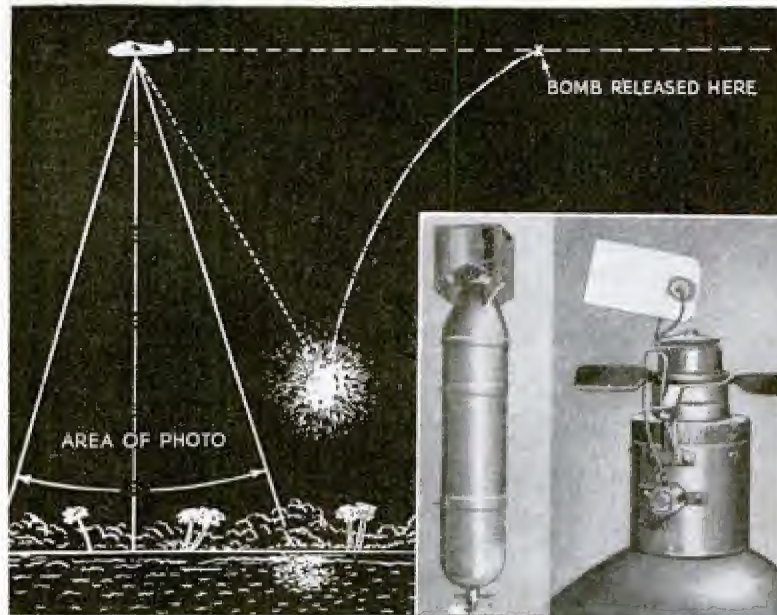
0204

Fitted with pontoons to land on water, helicopters may play an important part in rescuing men adrift in life rafts. In a recent demonstration conducted by Coast Guardsmen, a "wounded" flyer was rescued from a raft. The helicopter alighted on the water close to the raft and the "injured" man climbed into a stretcher basket attached to the craft. This eliminates much of the rough handling which is unavoidable in other methods of rescue. Helicopters are also used by the Coast Guard for patrol duty.



Photocell Trips Camera Shutter as a Flash Bomb Bursts

0155



Aerial photography at night has been improved and simplified with the aid of a photo-flash bomb which utilizes the same principle as the news cameraman's flash light. A fuse is set to explode the flash bomb at a point behind the plane. This in turn actuates a photo-electric cell which opens and closes the camera shutter. .Dropped in train, these bombs cause a sequence of pictures which can be combined into a mosaic. The flash does not show up in the picture except when reflected from water. The bomb contains 25 pounds of flash-light powder.

W. A. Army Air Force
Wright Field, Ohio

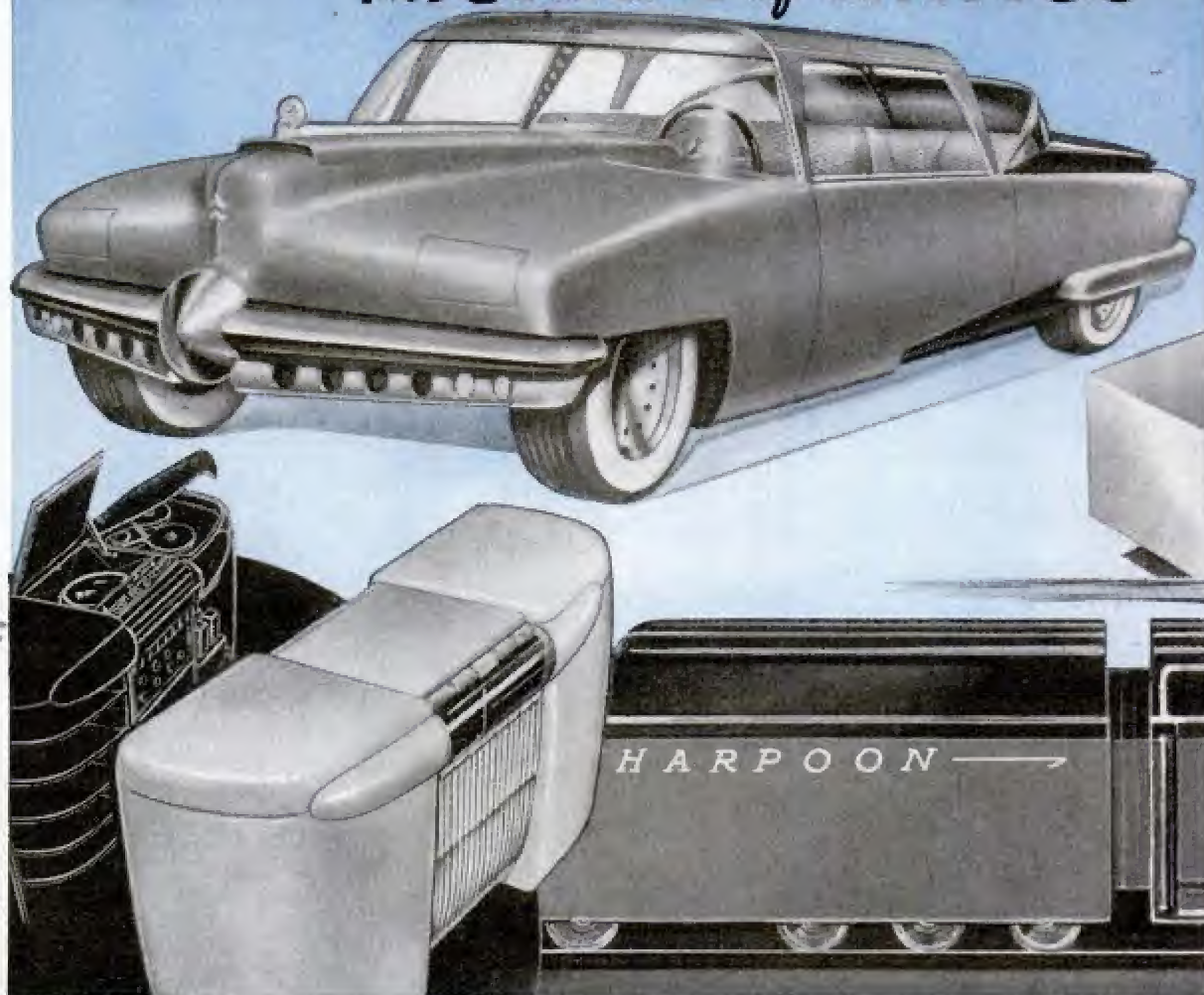
"Teardrop" Cockpit on Fighter Gives Pilot All-Around View

Pilots of North American P-51 fighter planes, top ranking pursuit ships in speed, range and ceiling, are assured 360-degree visibility with a transparent "teardrop" cockpit. This may give a pilot the split second of advantage in combat that often means life or death. The new cockpit cover is also an aid to night flying, for it can be rolled back to give an unhindered view and eliminate light reflections.



0221

The SHAPE of THINGS



At top is one of Raymond Logwy's conceptions of the automobile of the future. Below, at left, radio-television set designed in plastics cabinet by Sundberg and Ferar, including a magnetic-wire phonograph

580 7th Ave.
N. Y., 19 N. Y.

By Roderick M. Grant

Stephenson Bldg.
Detroit, Mich.

LIFE will never be the same again. The techniques and materials conceived under the impulse of war must inevitably bring vast changes in our ways of living, greater comforts and greater efficiency.

Home has never been an efficient thing. You pour more than half your fuel up the chimney and through the walls and windows. You furnish the house with lush carpets and overstuffed furniture that erupt clouds of dust at every movement. Paint and wallpaper perennially wither and fade. Summer dampness mildews, winter heat dismembers furniture. You tramp numberless miles from refrigerator to stove to dining table and back again.

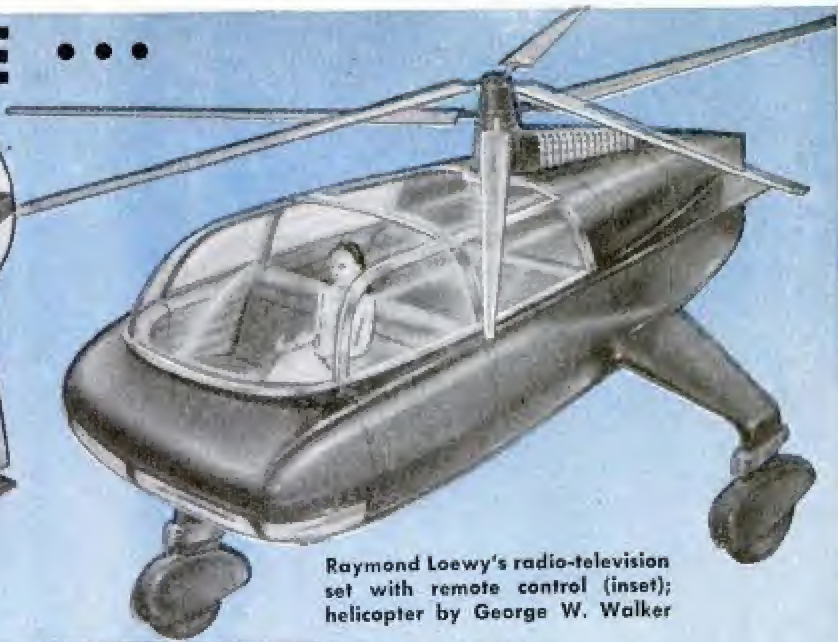
Your automobile was an enormity of chrome to be traded in at the first hint of a rust spot. It was heavy, it drank gasoline like a lord, it had blind spots, but it was

pretty and fast. You traveled in railroad cars probably twice as heavy as they need be, behind locomotives that delivered the goods effectively despite a technically inefficient power plant.

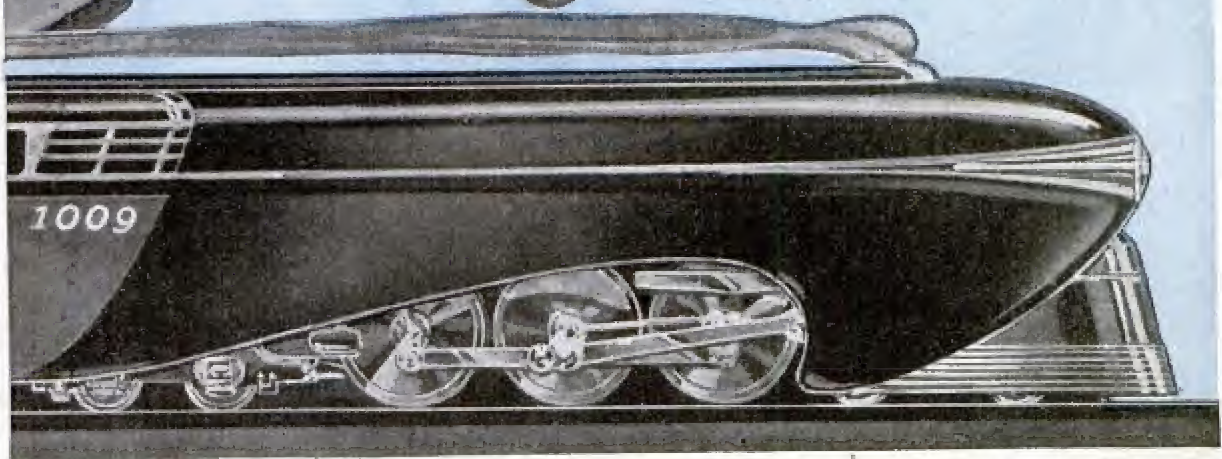
This is not to say that your p.f.c. will come home to a pink plastic house with dustfree air conditioning and a rear-engine-car traveling 50 miles on a gallon of 150-octane gas. But this is a promise that evolution of better living will begin when the war ends, for it has begun already on the drawing boards of American designers who are shaping the future for our builders and manufacturers.

When designers' dreams come down to earth, of course, economic considerations will dictate their form. Practicality ruled, for example, in the designing of a functional utility unit for the home, conceived by

to COME ...



Raymond Loewy's radio-television set with remote control (inset); helicopter by George W. Walker

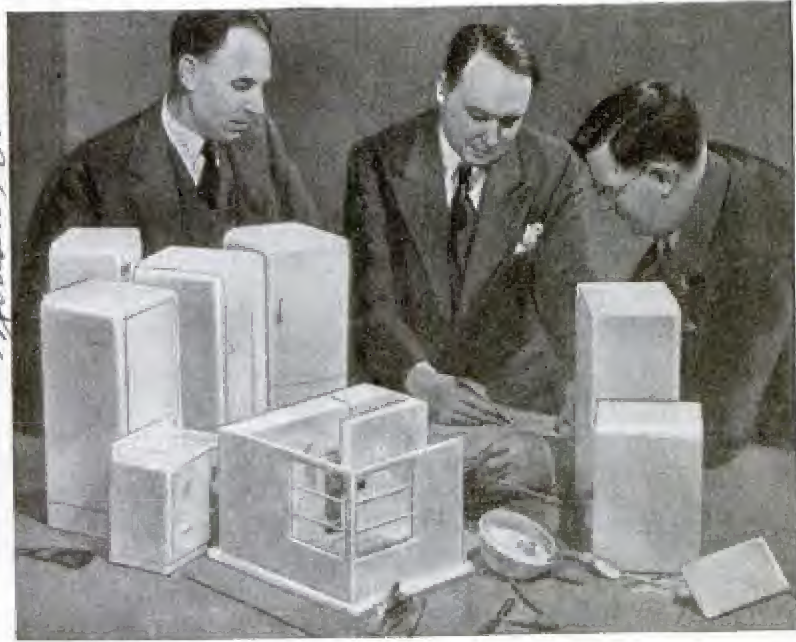


Notice "harpoon" shape of steam locomotive designed by Brooks Stevens. Below, engineers of Serval, Inc., study models of household equipment

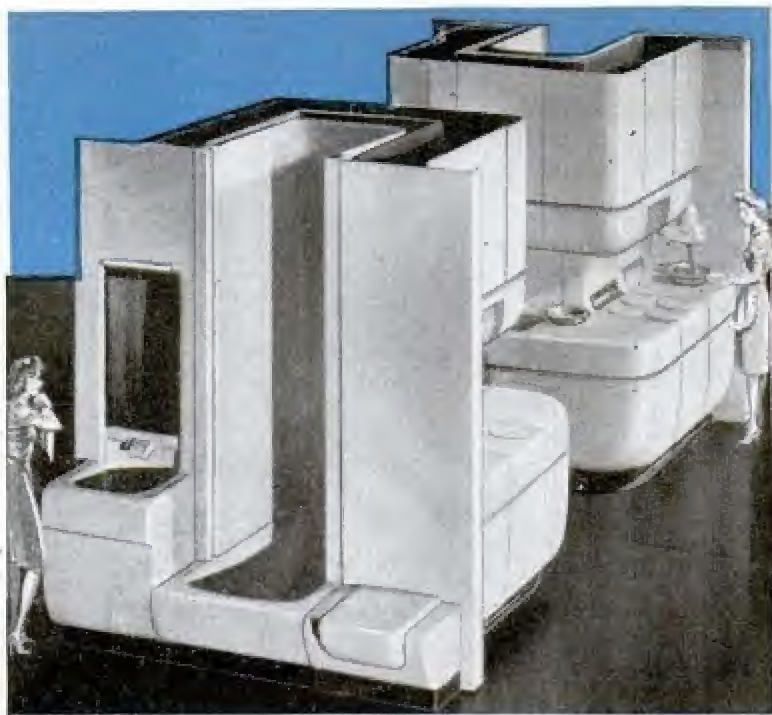
Sundberg-Ferar of Detroit for the Virginia Lincoln Corporation. In this unit, the newly-developed low pressure molding technique of forming large pieces of resin-impregnated fibrous materials is used to form bathroom and kitchen fixtures integral with standardized interchangeable wall sections. All plumbing, wiring and electrical ducts are built in, and quickly connected by flexible connections to gas, electric, sewage and plumbing outlets built into the foundation.

Morris, Del.

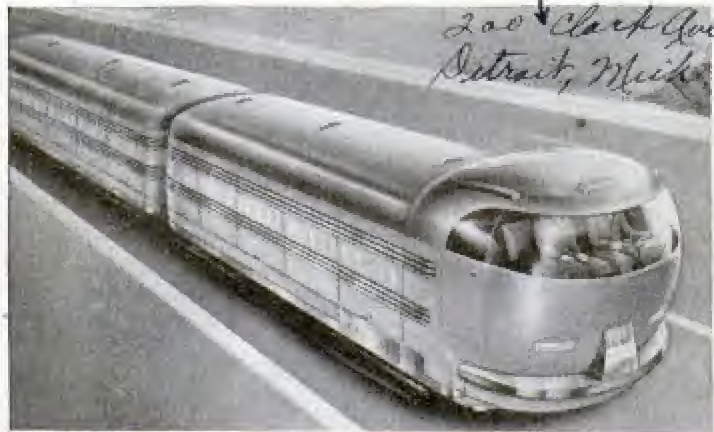
The kitchen has a built-in refrigerator with drawers instead of doors; a flick of the fin-



*340 N. Milwaukee St.
Milwaukee 2, Wis.*

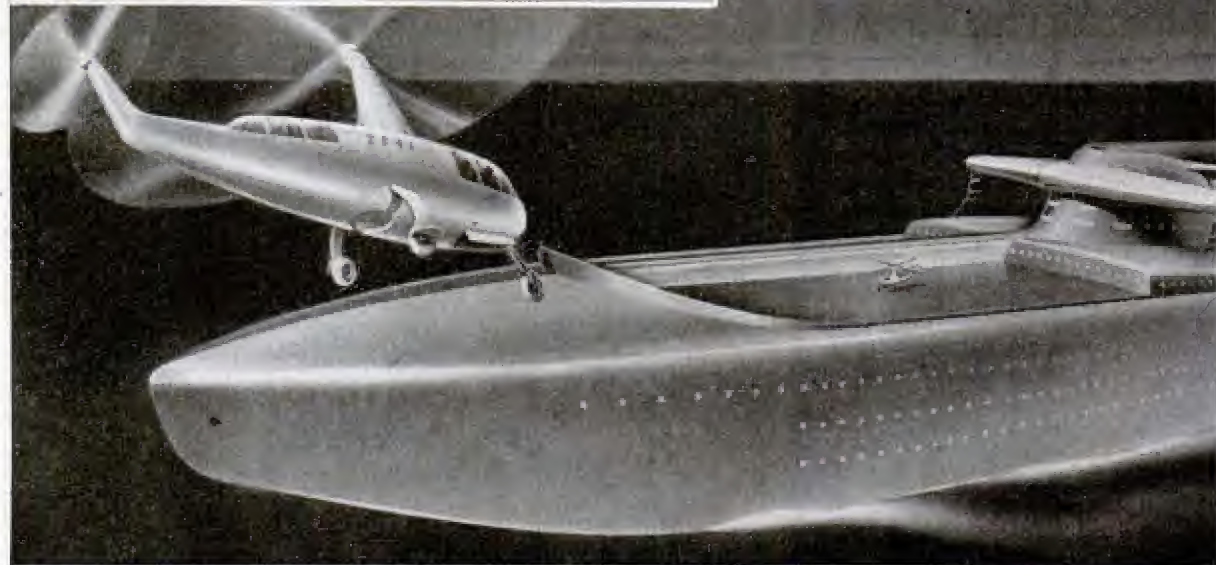


Tub and shower of bathroom (Sundberg & Ferar) fit into "U" of kitchen unit. Below, highway "livestock train" sketched for Timken-Detroit Axle Co.



Minneapolis-Honeywell Regulator Co., which will permit sectional regulation so that the living room can be maintained at 72 degrees, the bedroom at 65, the garage and attic at 50 or any desired level. This heat regulator, already used in large public buildings, can be installed in many existing home heating systems after

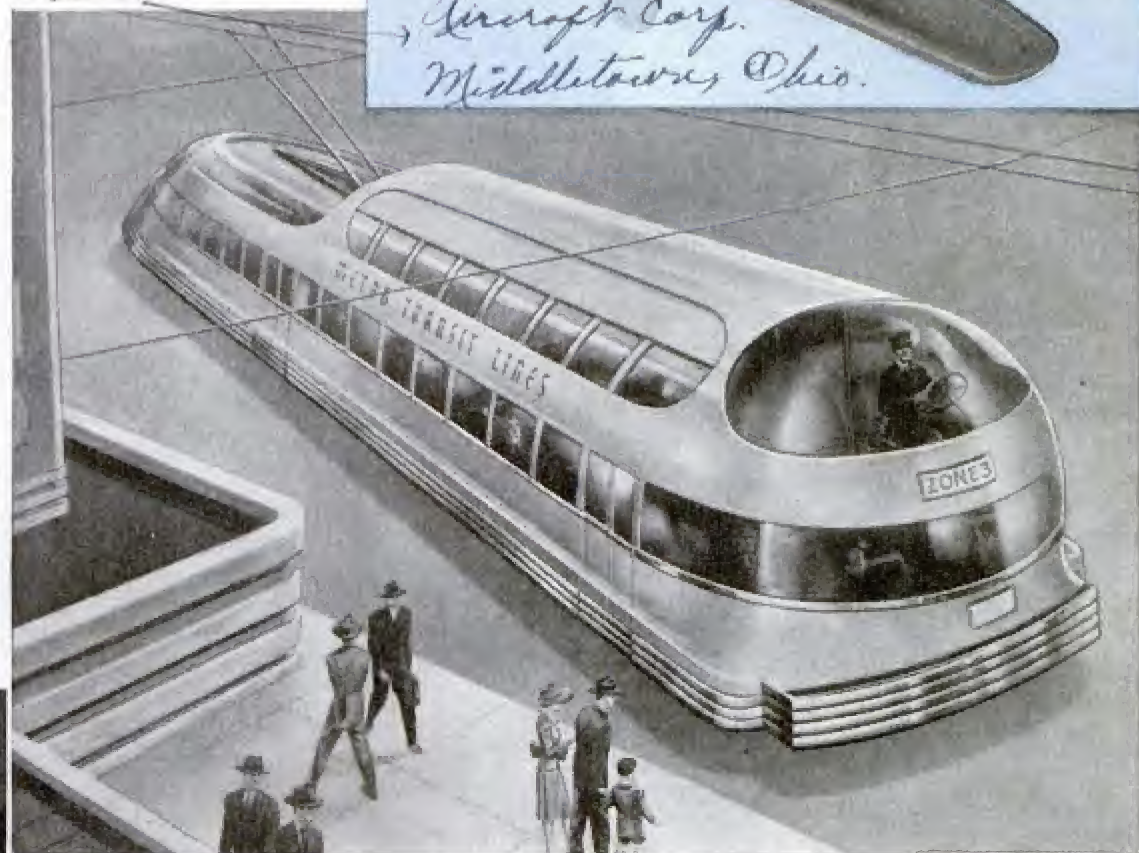
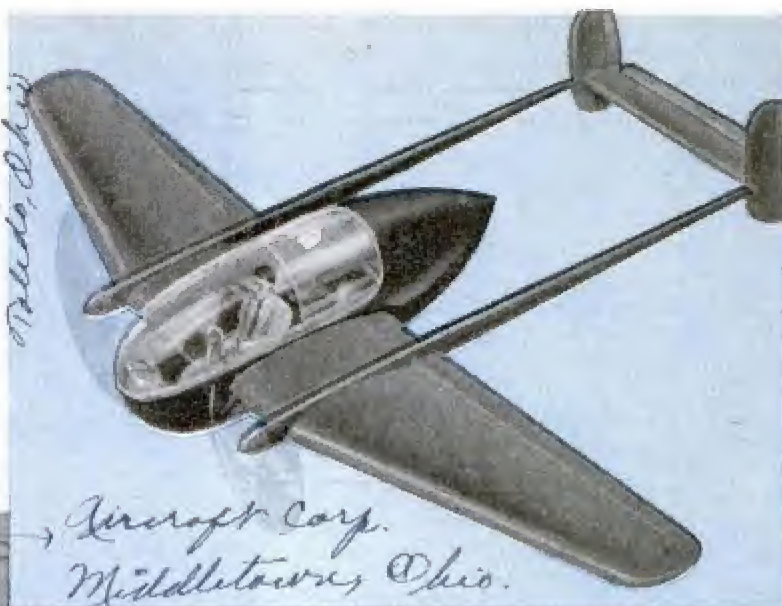
Turbo-electric liner with helicopter on deck, conceived by Raymond Loewy



the war to modulate the flow of heat to each room or section as required, wasting not a degree where it is not needed.

The home planners of the Owens-Illinois Glass company include in their preview a plastic refrigerator with an icewater tap, ice cube ejector, deep freeze unit, ultraviolet lamp to sterilize food, and a circular central section

The four-place family plane at right is an artist's suggestion of an Aeronca plane of the future



Timken-Detroit Axle Co.

This twin-deck trackless trolley with the driver upstairs, and with a sky-view "roll-back" roof, is proposed by one industrial engineer

with revolving shelves. They also suggest an electric eye that will see you coming and open the swinging door as you carry a tray of dishes from diningroom to kitchen . . . a waste pulverizer that chews up table scraps and old bottles . . . a cordless electric iron . . . windows that open at touch of a pushbutton.

Westinghouse looks forward to completely air-conditioned homes with dust and dirt collected from the air electrostatically by home-size Precipitrons . . . lockers to quick-freeze foods from your post-victory garden . . . automatic washing machines with electric driers and ironers.

It is pretty generally agreed that the next automobiles

built will be modified 1942 models. It is the car after the next that our designers are planning. George W. Walker, Raymond Loewy, Brooks Stevens, Sundberg and Ferar all have their versions of the streamline sedans of the future, some of them rear-engine models, nearly all emphasizing visibility through plastic windows and at least partly transparent roofs, and a minimum of corner-post obstructions. Family-size helicopters are also on the drawing boards, and Raymond Loewy as consultant engineer for the Greyhound Corporation has sketched a huge helicopter-bus which would have terminals on the roof of motor bus stations.

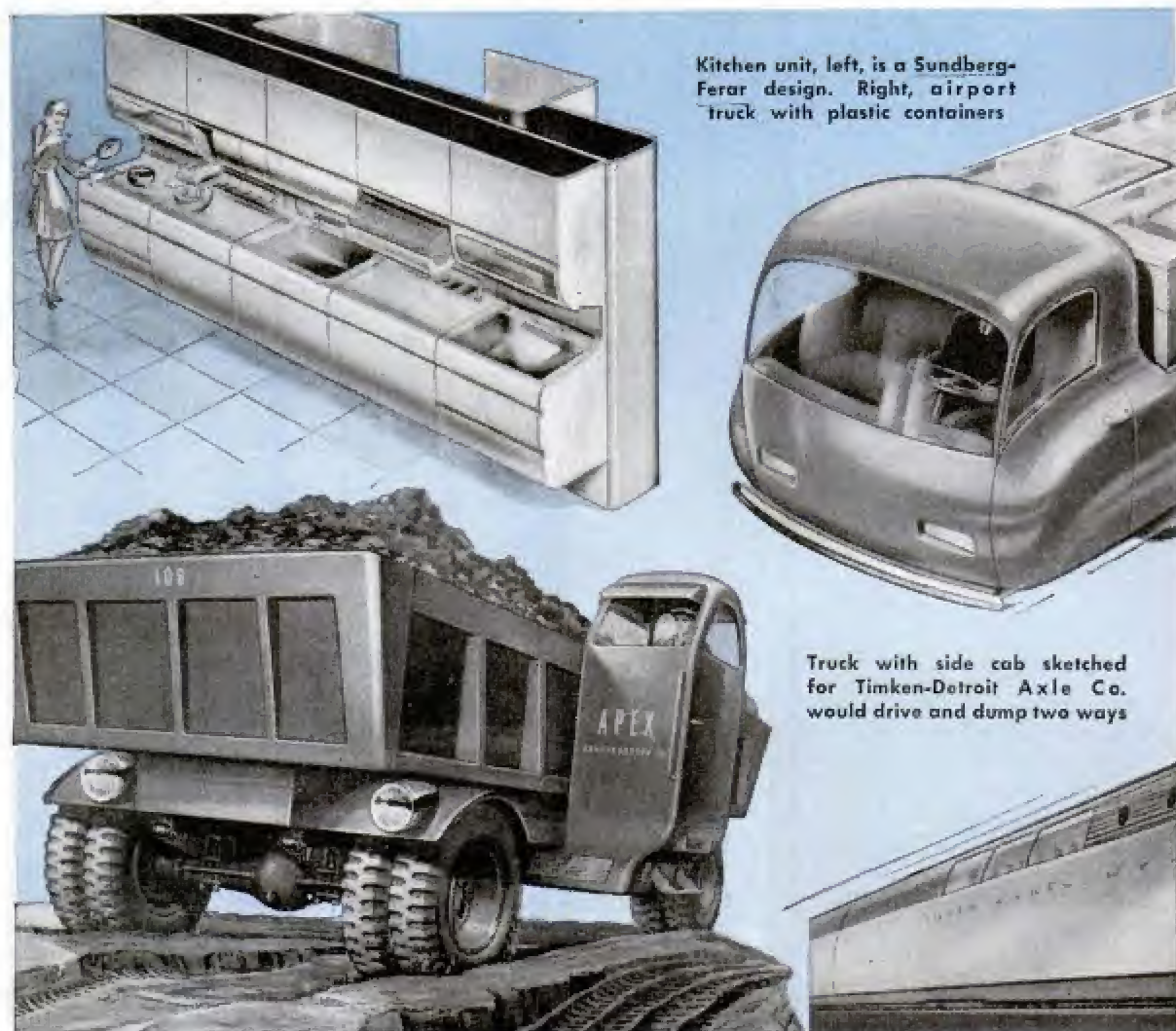
From the Timken-Detroit Axle company comes a whole album suggesting the "shape of things to come" from the truck and bus builders when their energies are no longer absorbed in building tanks and aircraft and military trucks. These "vehicles of tomorrow" sketched for the company by Lurelle Guild range from a twin-deck trackless trolley with a sky-view, roll-back roof to an earth-moving dump truck with an off-

set cab at one side, steering-driving axles at both ends permitting the truck to be driven in either direction without turning around, and dumping its load both fore and aft. Timken-Detroit also visualizes delivery trucks with merchandise display panels in the sides, airport trucks carrying plastic containers loaded with packaged goods for air cargo shipment, and huge tractor-trailer combinations specially designed for hauling livestock, milk, oil, passengers, produce.

"The day of the 'all-purpose' truck is gone," the Timken-Detroit company points out. "Just as livestock differs from household goods, so should the trucks and trailers that carry each be designed for its particular kind of load. . .

"From the crucible of war have come great technical advances. . . Fuels that get more power from new engines. Lighter but stronger metals that reduce over-all weight, yet serve better the purposes of safety.

"All this is on the side of vastly improved performance, longer life, greatly reduced



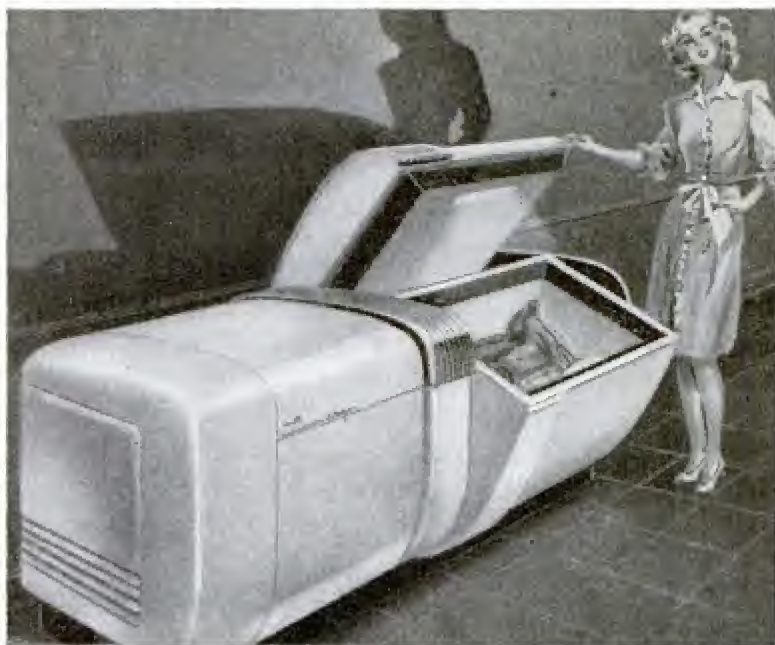
Kitchen unit, left, is a Sundberg-Ferar design. Right, airport truck with plastic containers

Truck with side cab sketched for Timken-Detroit Axle Co. would drive and dump two ways

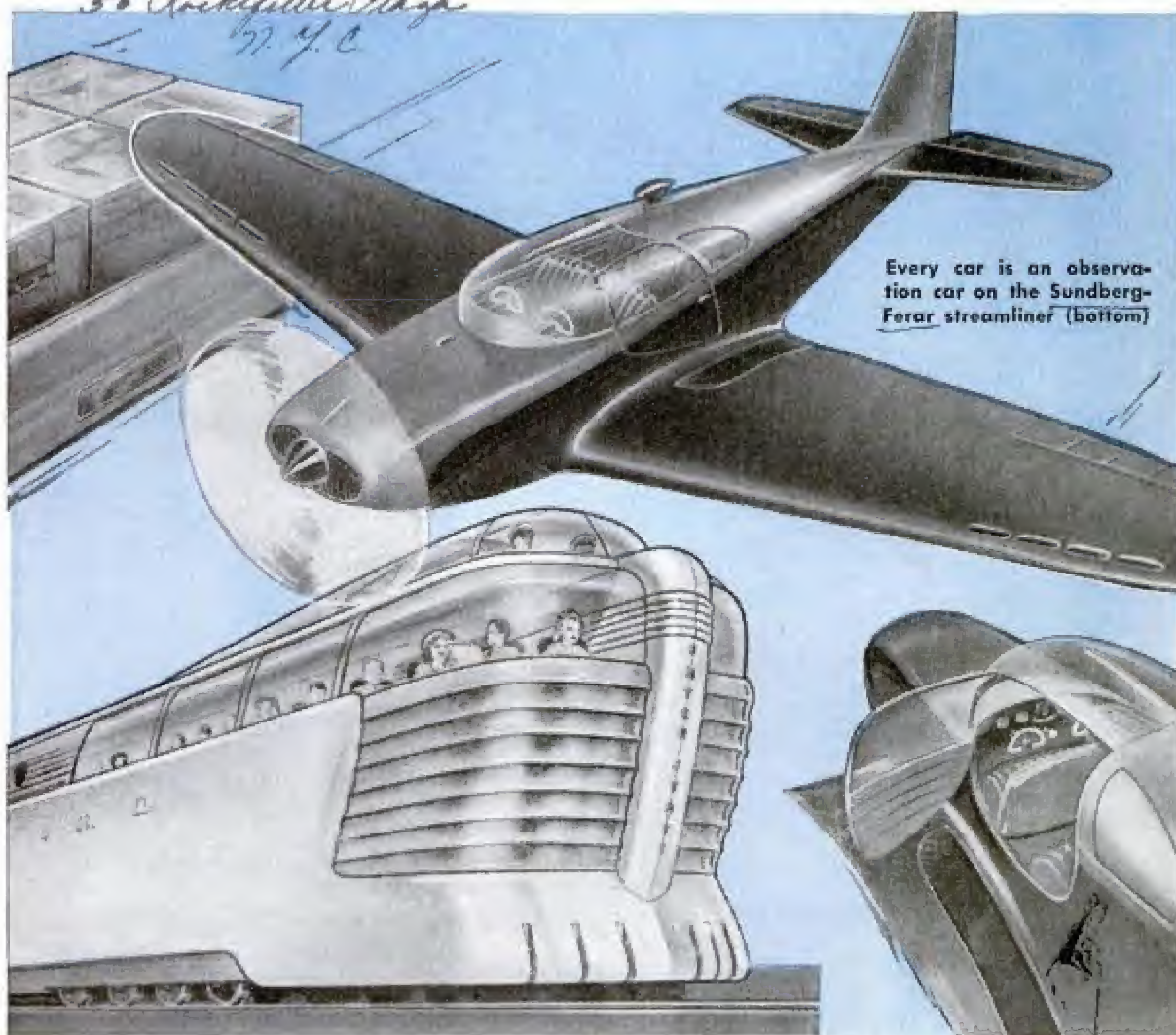
operating and maintenance cost. And already on the drawing boards of designers are the sketches of bodies that will increase carrying capacity, reduce 'drag,' promote safety, facilitate loading and contribute greatly to the comfort of all who drive or ride."

Surveys have indicated that more than 1,000,000 families will undertake home improvements shortly after the war, 1,000,000 new homes per year will be built, and there is a vast market accumulating for new automobiles, radios, television and FM, refrigerators, washing machines and so on and on.

As Norman Bel Geddes and company, industrial



The home freezer unit is a Brooks Stevens design. The same artist borrowed from automotive styling in prophetic sketches of lightplane, below



Every car is an observation car on the Sundberg-Ferar streamliner (bottom)



Timken-Detroit Axle Co.

Tomorrow's light delivery truck may have changeable merchandise showcase

designers, have said: "The destruction and obsolescence of equipment and traditional ideas prompted by the war is a Godsend to us all. It offers the opportunity to start over, with the knowledge and experience of the past and the confidence that we can do for peace what we did for war. We should no longer be handicapped by dated ideas and methods."

Furniture and textiles are bound to undergo changes as molded plywoods and plastics and synthetic fibers have their first chance at peacetime competition. Many of the postwar automobile plans propose woven plastics for seat coverings.

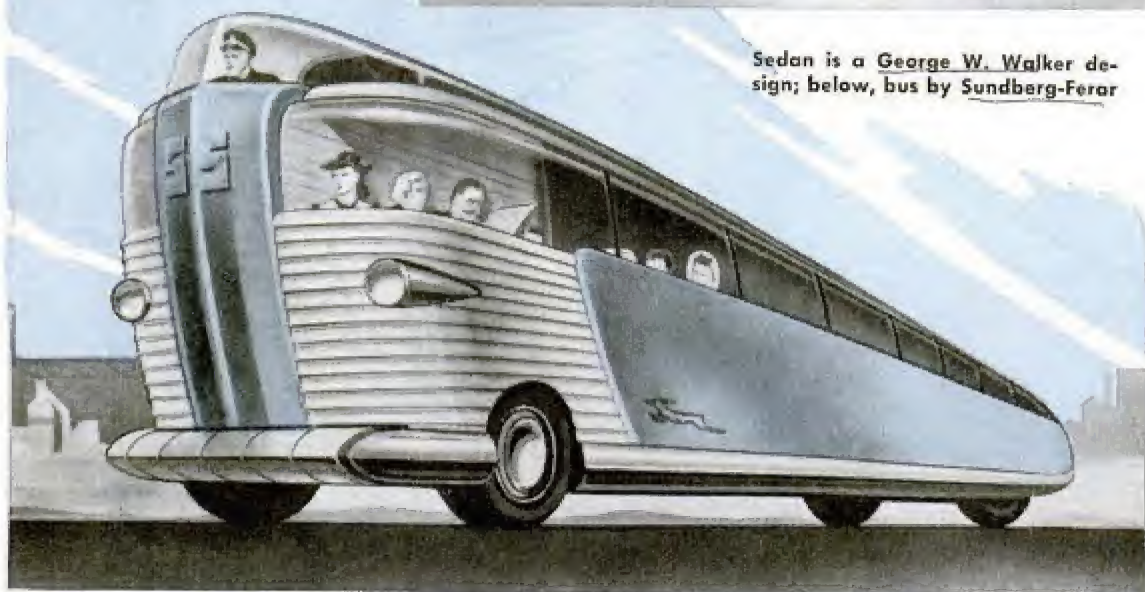
Sundberg and Ferar have suggested a plastic chair designed for comfort, its body molded by the "heatronic" method with large presses. Instead of "clumsy steel springs," the designers propose a preformed sponge-rubber cushion and a zipper fastening the upholstery of woven extruded plastic to the chair. The back and legs would be transparent, and the chair would be shaped to support the body at every point.

Brooks Stevens, whose postwar ideas range from a streamline locomotive to a refrigerator

with a transparent-plastic corner window, offers a novel suggestion of molded plastic tableware. Modern plastics, he points out, offer an infinite variety of form and color possibilities, and since it is no



Sedan is a George W. Walker design; below, bus by Sundberg-Ferar





Raymond Loewy styled this proposed helicopter bus, seating 14 passengers, for the Greyhound Corporation

longer necessary to adhere to the traditional round plate form inherited from the pottery wheel, he has molded plates with a modern motif, a straight edge on one side.

Changes in home equipment must be evolutionary, not revolutionary. Old houses have always been the principal market for new appliances, and designers must stay close to tradition to fit the new stove or refrigerator into the old house.

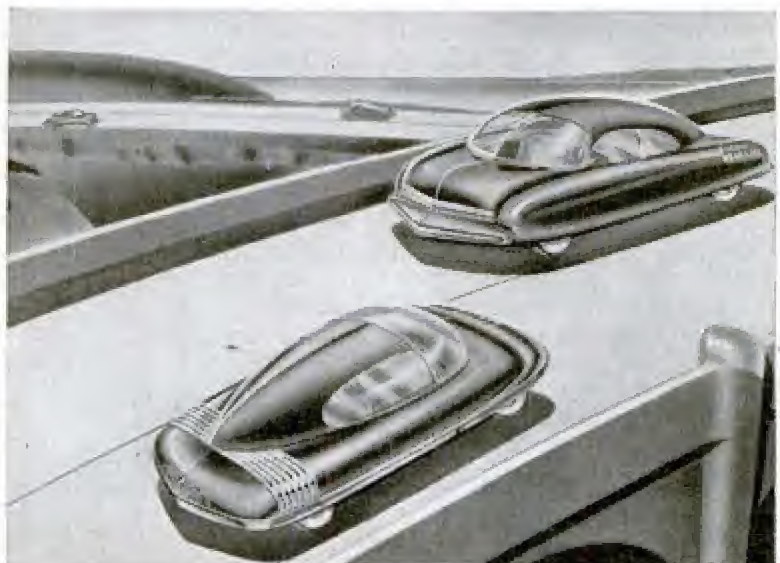
Sundberg and Ferar point out that "universal application of plastics" is a myth.

"Two prime factors will retard the spread of this versatile material into many fields," they say: "dimensional stability and impact strength. Both must be greatly increased, and plastics in general must be greatly reduced in cost if their use is not to be limited to gadgets and ornaments.

"There are, however, three recent developments in the plastic field which do show promise for the future if the cost of production can be made compatible with peacetime economics. One is heatronic molding permitting faster cycles and larger pieces; the

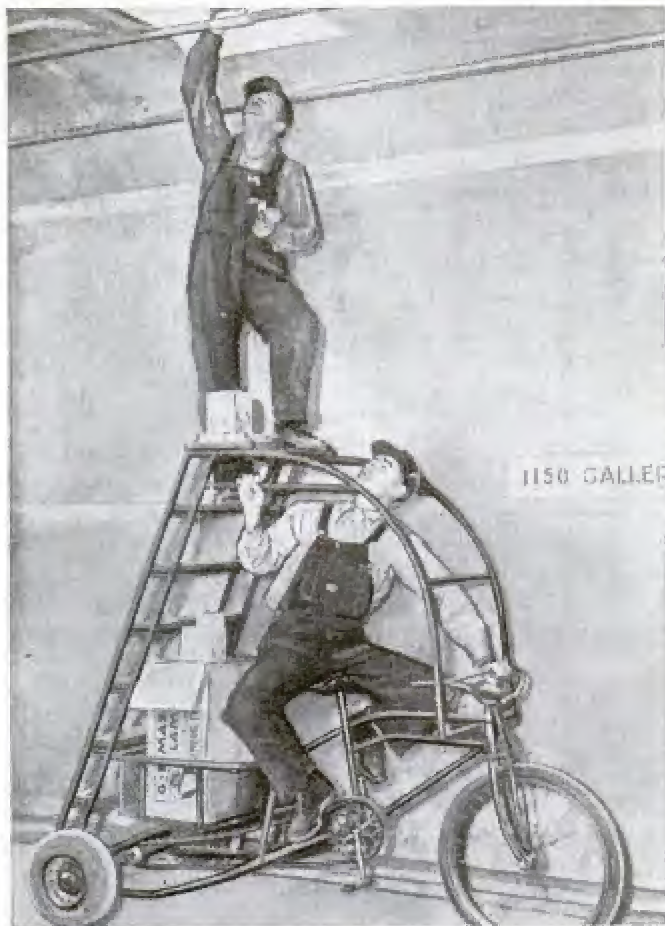
second is the development of a relatively hard and thermostable transparent allyl resin still in the experimental stage; the third is low-pressure molding in which resin-impregnated cloth, paper or plywood can be formed by heat and low pressures."

Money is no object in war. Thus much of the pioneering research that will eventuate in the new products and processes of peace has already been charged off. But money is the dictator in peacetime industry. The innovations in store for your new way of living will come gradually as the dreams of the designers prove marketable and economical and sound.



George W. Walker, automotive designer, calls the drawing at right "Highways of Tomorrow"

Stepladder Mounted on Tricycle Speeds Tunnel Maintenance



Two-man crew servicing lights in tunnels of Grand Coulee dam

Burned-out light globes in the miles of tunnels inside Grand Coulee dam are quickly replaced by a two-man crew that travels on a special tricycle. Mounted on the tricycle is a stepladder and platform from which it is easy to reach light sockets. Two men service the 2,800 lights in eight and one-half miles of tunnels, replacing about 400 burned-out globes each week.

Warplanes Set Speed Records Cross-Country and Atlantic

Dinner in Los Angeles and breakfast in London the next morning is the pace for air travel recently set by record-breaking U.S. and British warplanes. A P-51 Mustang fighter plane broke the cross-continental speed record by traveling from Los Angeles to New York in 6 hours, 31 minutes and 30 seconds. This included a stop of 6 minutes and 25 seconds in Kansas City for refueling. The Mustang, which averaged 390 miles per hour in flight, beat the Los Angeles-Washington record of the

Constellation by 26½ minutes. A new trans-Atlantic speed record was set by an R.A.F. Mosquito bomber by flying the 2,200 miles from Labrador to England in six hours and 46 minutes. A previous record of eight hours and 56 minutes for the same route was held by a Liberator bomber. The Mosquito averaged 325.12 miles an hour on the trip.

Army Measles Preventive Made of Blood Plasma

Large supplies of gamma globulin, which contains the antibodies developed in the blood to fight measles, are now available to United States Army soldiers. The globulin is obtained by the War Department from Red Cross blood plasma, since most adults have had the disease.

"Man in the Iron Mask" Is Jap at Bayonet Drill

Enemy equipment captured by the United States Army on Kwajalein Island indicates that the Japanese soldier dresses up like one of King Arthur's knights before practicing bayonet fighting. The captured uniform included an iron mask, a barrel-like chest guard, and pads to protect the head and loins similar to those worn in medieval times.



Soldier models bayonet drill togs captured from Japs

Col. Clair Peterson & Lt. Col. Jack Carter - A.G. F. - Mustang

Mr. Colvin, Cal.

0260

0206

1150 GALLER

0262

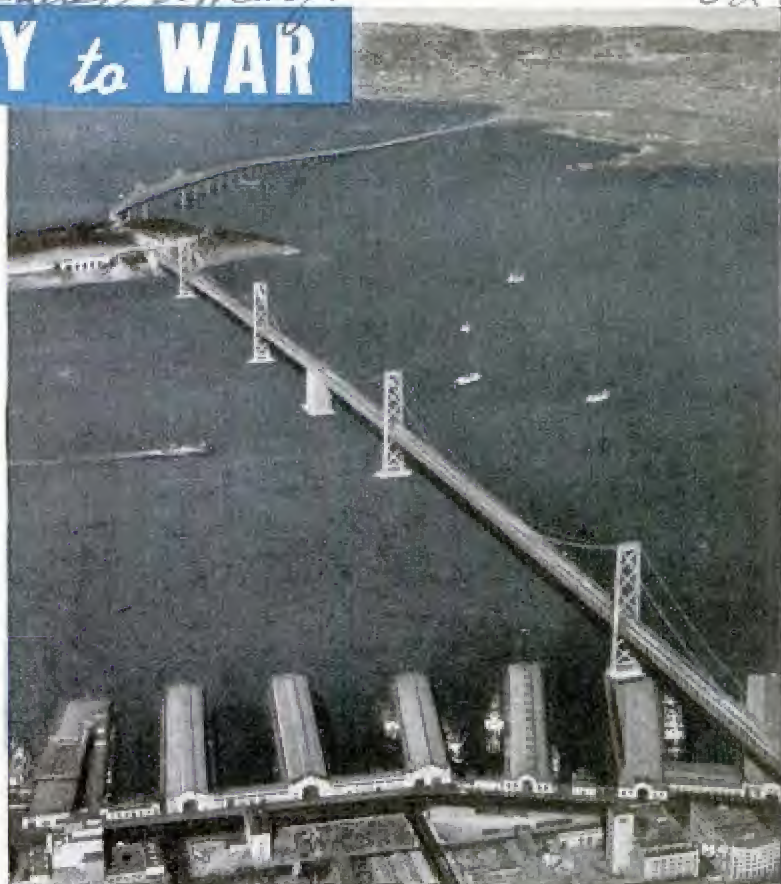
Mr. Stinson, Jr.
3872 Franklin Ave.
San Angeles 27, Calif.

0249

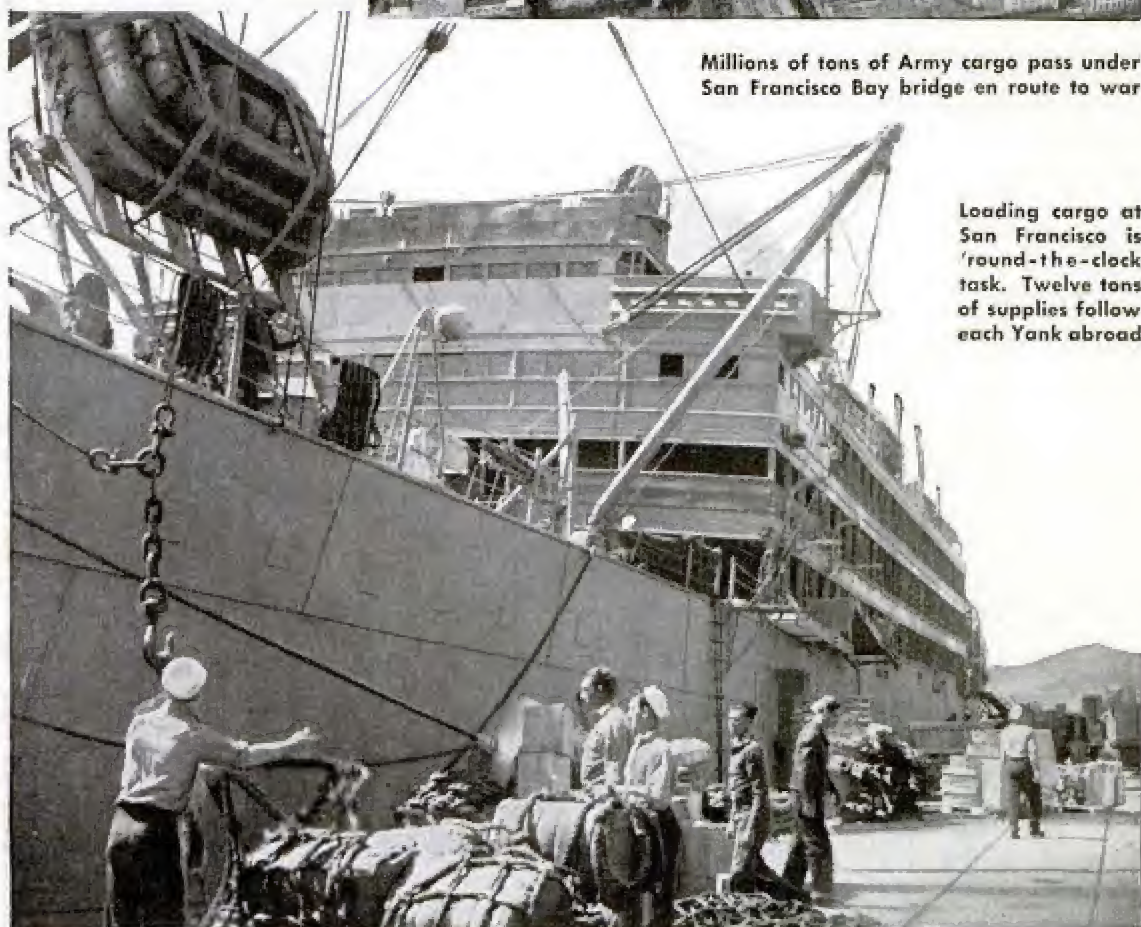
GATEWAY to WAR

DURING the first few months of the war more military supplies moved through the port facilities of San Francisco Bay than all other ports of the United States combined. Now, with the Pacific push gathering impetus, the outward flow of troop transports, ammunition ships, and war vessels of every description from the Golden Gate is at a peak again.

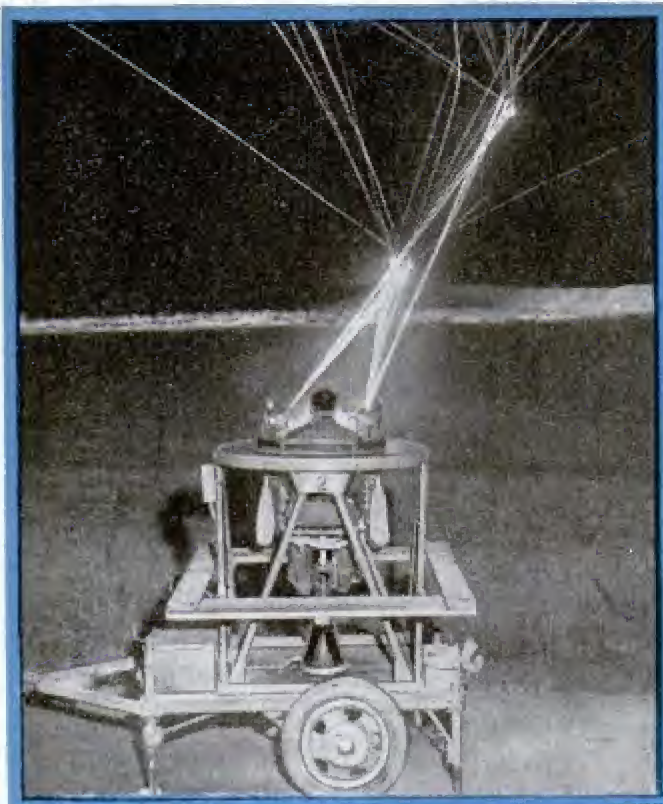
San Francisco Bay has been called the "heart and strategic center of offensive operations in the Pacific." It is all that and more. Here are the headquarters of the Western Sea Frontier, the Western Defense Command, and the Fourth Air Force. Exposed to possi-



Millions of tons of Army cargo pass under San Francisco Bay bridge en route to war



Loading cargo at San Francisco is 'round-the-clock' task. Twelve tons of supplies follow each Yank abroad



Official U. S. Navy photo

Night practice with tracers on naval range at San Francisco. Below, men load scout cars for movement to embarkation port

ble enemy attack, it is well guarded ashore by the Army and well protected offshore by the Navy. Practically every civilian activity in the area is connected with waging war. Wartime increase in population is greatest among the metropolitan areas and 100,000 new housing units have not been enough to fill the need.

Not all details of wartime activity can be told, although it has been announced that one of the world's greatest arsenals is located on the bay and that the nation's greatest naval base and supply depot are likewise in the area. One fourth of the country's ships, involving contracts of more than three billion dollars awarded during the last four years, are being built by Bay yards. Liberty ships were launched by one yard at the rate of one per day during a recent one-month period.

The activity at Mare Island Navy Yard is typical of the whole Bay region. Mare Island is not only building surface ships and submarines, it repairs warships that have received battle damage and assembles destroyer escorts



that are shipped from prefabrication points as far away as Denver. LCT's, sometimes jocularly called "Large Cattle Trucks" by their crews instead of "Landing Craft—Tanks," and other small ships and craft are also assembled at Mare Island.

During the last two years this Navy yard trebled in size and now employs nearly 50,000 workers. To get this number of people to and from their jobs requires 280 buses that travel more than the distance around the world each day. Cafeterias in the yard serve 11,000 hot meals daily and twice that number of lunches from mobile canteens.

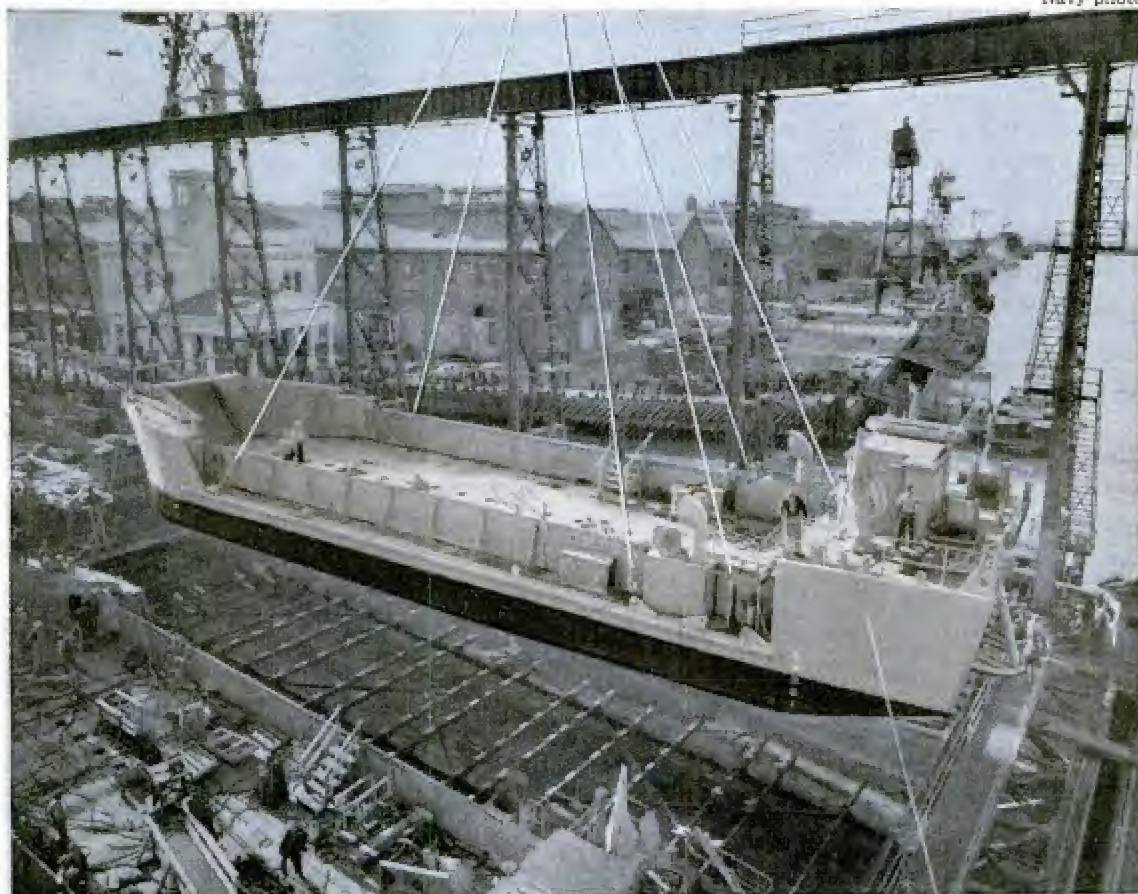
On top of all its other activities, San Francisco Bay is the site of the San Francisco Port of Embarkation. A port of embarkation is an installation of the Transport Corps, Army Service Forces, and com-

prises a port where ships are assembled and where troops and supplies are received from interior zones for transshipment overseas. Embarkation facilities include huge Army installations, vast commercial



Relaying orders at the control tower of naval air station along the bay

Floating crane at Mare Island Navy Yard lifts a finished LCT off the ways and places vessel in the water
Navy photo





Inspecting spare gun tubes awaiting shipment abroad

waterfront terminals, motor inspection bases where vehicles receive final servicing before being shipped, Army post offices for handling incoming and outgoing overseas mail, and miles of docking space. It is the home base of the troops overseas.

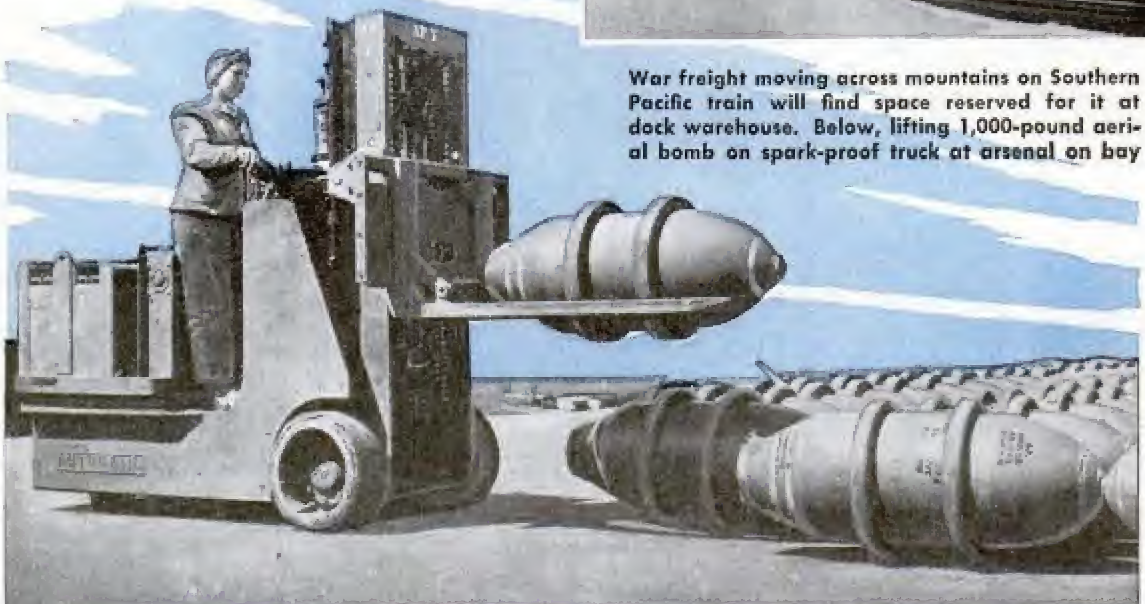
A modern army requires prodigious amounts of equipment and supplies. An infantry division may use 542 tons of ammunition alone in one day. At least 15 Liberty ships and troop ships are needed to transport an armored division and this division in action may consume thousands of gallons of gasoline per hour. Up to 12 ship tons of equipment accompanies each man who goes overseas and nearly another one and a half ship tons of food, clothing, and supplies must be shipped out

every month to keep him in combat.

During the last war nearly half of all the supplies used by the A.E.F. were obtained abroad. This time, not only are the requirements much higher per man, but practically all such supplies must be shipped from the United States. More than 25 million tons of Army cargo had moved overseas from all three coasts by the beginning



War freight moving across mountains on Southern Pacific train will find space reserved for it at dock warehouse. Below, lifting 1,000-pound aerial bomb on spark-proof truck at arsenal on bay



of 1944, more than two and a half times as much cargo as was shipped abroad during World War I. In addition to all this are the enormous quantities of supplies that go to our Allies.

Moving such vast amounts of goods is an unparalleled task. Originating possibly on Kansas farms, in Texas oil fields, and in Michigan motor plants, all the supplies must be funneled through the ports of embarkation. During



Navy gunners practicing with twin-mounted 40 mm. antiaircraft guns on beach overlooking Pacific Ocean, and near busy port of embarkation

the last war, transportation of war goods bogged down. Loaded freight cars blockaded the rails leading to the main ports and at one time 200,000 loaded cars were strung out, stalled, from east coast ports all the way back to Chicago.

No such congestion has occurred this time, due to the planning of the Transportation Corps. Freight is not started toward a port until it is known that space will be available. En route the loaded cars pass through military regulating stations where the

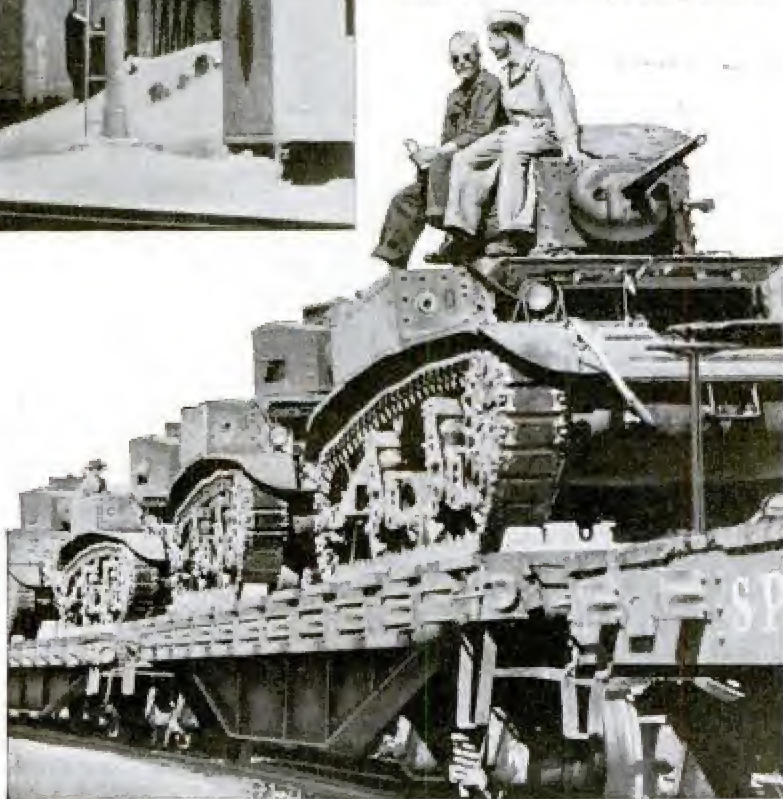
movement of individual cars may be expedited, delayed, or diverted according to the latest schedules from the ports. Possibly a ship that is due to load cargo two weeks hence is torpedoed on its way to port; at the regulating station the freight that was destined for that ship is diverted to another port or is held back until another ship will be available. The regulating stations are located as far inland as the Rocky Mountains.

If it turns out that shipping space is not available at the last minute or when there is an urgent change in priorities, freight arriving at a port is sent to a holding and reconsignment point located within an overnight's run of the port. These points are reser-

Continued to page 158



Trainload of fighting tanks moves toward the Pacific "Gateway to War"



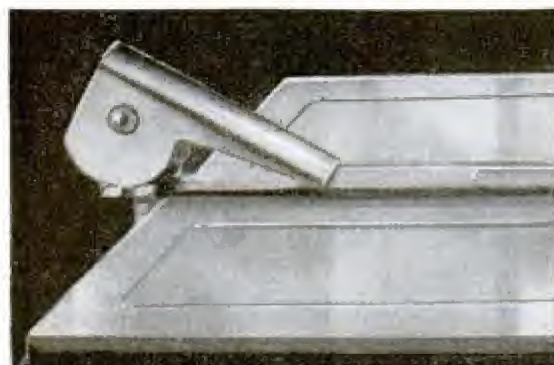
X-Rays Diagnose Damage⁰²¹⁹ At Aircraft "Hospital"



When a bomber or fighter plane limps home with a damaged part, it is immediately sent for treatment to one of the many airplane "hospitals" scattered throughout England and northern Ireland. There the "injuries" are X-rayed and all the ship's wants are looked after. Technically, the "hospitals" are Base Air Depots of the Air Service Command and their job is to supply the Air Force with anything it needs.

Car Battery Is Changed in Jiffy⁰²¹³ With Quick-Releasing Clamp

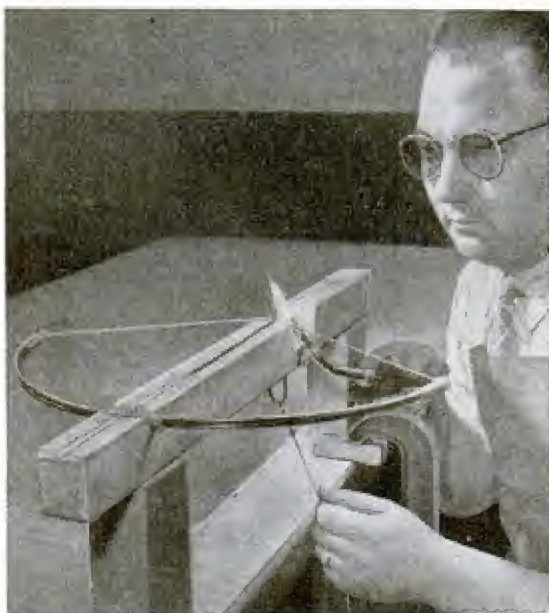
Automobile batteries are removed with ease and speed when held in place by a cam-action clamp. Instead of bothering with the conventional wing nuts, all a mechanic has to do is release the cam lever and lift the battery out. The clamp is easily fastened to battery boxes on cars, trucks



or busses, and holds a battery firmly in place. It is said to eliminate the need of safety wiring.

Science Puts Crossbow to Work⁰¹⁸⁹ Drawing Quartz Filaments

Adapting Robin Hood's favorite weapon to scientific purposes, Westinghouse research engineers shoot an arrow from a crossbow to draw out delicate quartz filaments used to measure the magnifying power of an electron microscope. The engineer places the steel bow in firing position on a wooden stock and attaches the arrow to a small, cylindrical piece of quartz. With the hot flame of an oxy-hydrogen torch he heats the quartz until it is just about to melt, then pulls the trigger. The arrow darts from the bow at high speed, trailing gossamer-like threads of quartz so fine that it would take 60 to match the thickness of a human hair. The filaments are 1/30,000 inch in diameter.



Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Save That Paper!

It may be only a petty annoyance to you, this shortage of paper. But to the war industries that need it, and to the Yankees overseas, a paper famine can be serious.

With your cooperation there need be no shortage. Yesterday's newspaper is of no value to you. But yesterday's newspaper, that empty candy box, the batch of advertisements you tossed in the wastebasket, the carton that brought today's groceries—these are the makings of the paperboard boxes that carry ammunition and field rations to the boys doing the fighting for you.

Save every scrap of paper for salvage. Waste-paper dealers, your favorite charity or the local salvage committee will tell you what to do with it.

By Paul Healy

IF THE domesticated members of the animal kingdom were to go on a sit-down strike, they might justifiably be accused of sabotage—even in this highly mechanized war. Allied commanders would wonder how to move equipment over mountain trails and through jungle swamps, how to communicate with one another without radio, how to scent a hidden enemy. Since the Axis would be similarly handicapped, opposing forces in certain theaters might be unable to come to grips.

Fortunately, however, animals still support man's war efforts faithfully and well, even though their tasks have been increasingly taken over by machines since Hannibal overcame the Romans with elephants, oxen and horses. There are crises when all the inventions of science are useless and man must call upon a dog, horse, mule, pigeon, camel or elephant for help. And nine times out of 10 he can count on heroics which neither he nor his machines could surpass.

Consider Caesar, a German shepherd trained as a Marine Corps "devil dog." Caesar landed on Bougainville with the first assault wave. On the first day, as

OUR ANIMAL ALLIES



Rin Tin Tin III (above) is one of thousands of "mercy dogs" trained for Red Cross work by U. S. Army. Below, mule bearing pack litter for field artillery unit stationed in New Guinea





Above, Army sled dogs hauling machine gun and operator. Left, a pigeon being released with a message



the only means of communication between Company M and the battalion post, he carried messages and captured Jap papers in nine round trips totaling 31 miles, two of the trips under fire. Once when Caesar and his master were advancing toward the enemy lines, with the dog "pointing" camouflaged snipers and pillboxes, his sensitive ears detected the click of a hand grenade several yards ahead. Caesar darted forward and sprang, catching the Jap's throwing arm in mid-air. The grenade dropped and exploded, killing the Jap and wounding Caesar in the hip and side.

Several other Marine canines also won distinction on Bougainville, such as Andy, a Doberman Pinscher, who led Company M to the Jap road block a few hundred yards inland. His ears located a machine gun nest where 15 Japs were annihilated.

On the steep, rocky slopes of Italy (below) horses replaced trucks in packing supplies and equipment





On practice maneuvers Dalmatian war dog (above) locates "wounded soldier." Soon he will return leading first aid unit. Below, paratrooper rehearses sending message by homing pigeon as soon as he has landed in enemy territory

Lt. Col. Alan Shapley officially described the work of the War Dog Platoon of 24 canines and 55 men as "an unqualified success." True to training, not one dog barked on Bougainville.

Duke, a German shepherd who could scent a Jap three quarters of a mile away when the wind was right, became the Sergeant York of the dog world during some of the hottest fighting of the South Pacific. On New Guinea he was credited with flushing 50 Jap snipers. At Cape Gloucester he uncovered 80 Japs, of which 60 were killed, the rest captured.

Fiercest of the dogs used in this war were the "anti-tank" animals trained by the Russians. On the Kalinin front packs of dogs charged advancing Nazi tanks, leaping against their sides to deposit bombs carried in their muzzles, and then streaked back to escape the explosion. Nine heavy tanks and two armored cars were reported destroyed on one of these fantastic forays, but the trick later was abandoned because of the large number of canine casualties it entailed.

The modern war dog is a refined descendant of the blood-thirsty mastiffs loosed against the foe in medieval times. He is a sentry standing watch outside war plants and military posts and along the beaches with the Coast





Cavalry mount (above) learns to wear gas mask. Note double canister. Below, "Sarah," a duck, is mascot of an RAF squadron



Guard; like Caesar, Duke and Andy, he is a messenger and a spotter and occasionally he carries supplies and strings telephone wires; he pulls sledges and ammunition carts in Newfoundland and Alaska; and in No Man's Land he guides first aid units to the wounded. In combat he is directed by the "silent whistle" which is pitched too high to be audible to human ears.

It has been a long time since generals rode white chargers and mounted troops dominated a battle. Nevertheless, the loyal, hard-working horse still plays a vital, if less spectacular, wartime role. Right after the German Army made the mechanized division famous in the Low countries in the spring of 1940, the Wehrmacht turned up with 800,000 military horses, some of which accompanied the infantry into territory won by the panzers, thus saving fuel and rubber. Japan is said to have used 300,000 horses against China and 75,000 more in the big Pacific offensive of 1942.

Our War Department stepped up horse purchases from 2,000 annually to 23,000 in 1941 and sent an SOS for soldiers to attend a school for horseshoers and saddlers at Fort Riley, Kas. Many artillery officers had always admitted the horse is indispensable for moving supplies off roads and

Below, a placid camel rests after hauling a supply wagon "somewhere in India"





Above, an Indian elephant carries bedding for U. S. troops. Below, sentry dog bares fangs outside camp

through darkness, rain and mud. Their opinion was proved time after time in the Philippines and in the mountains of Italy, where motor vehicles frequently became stalled or wrecked.

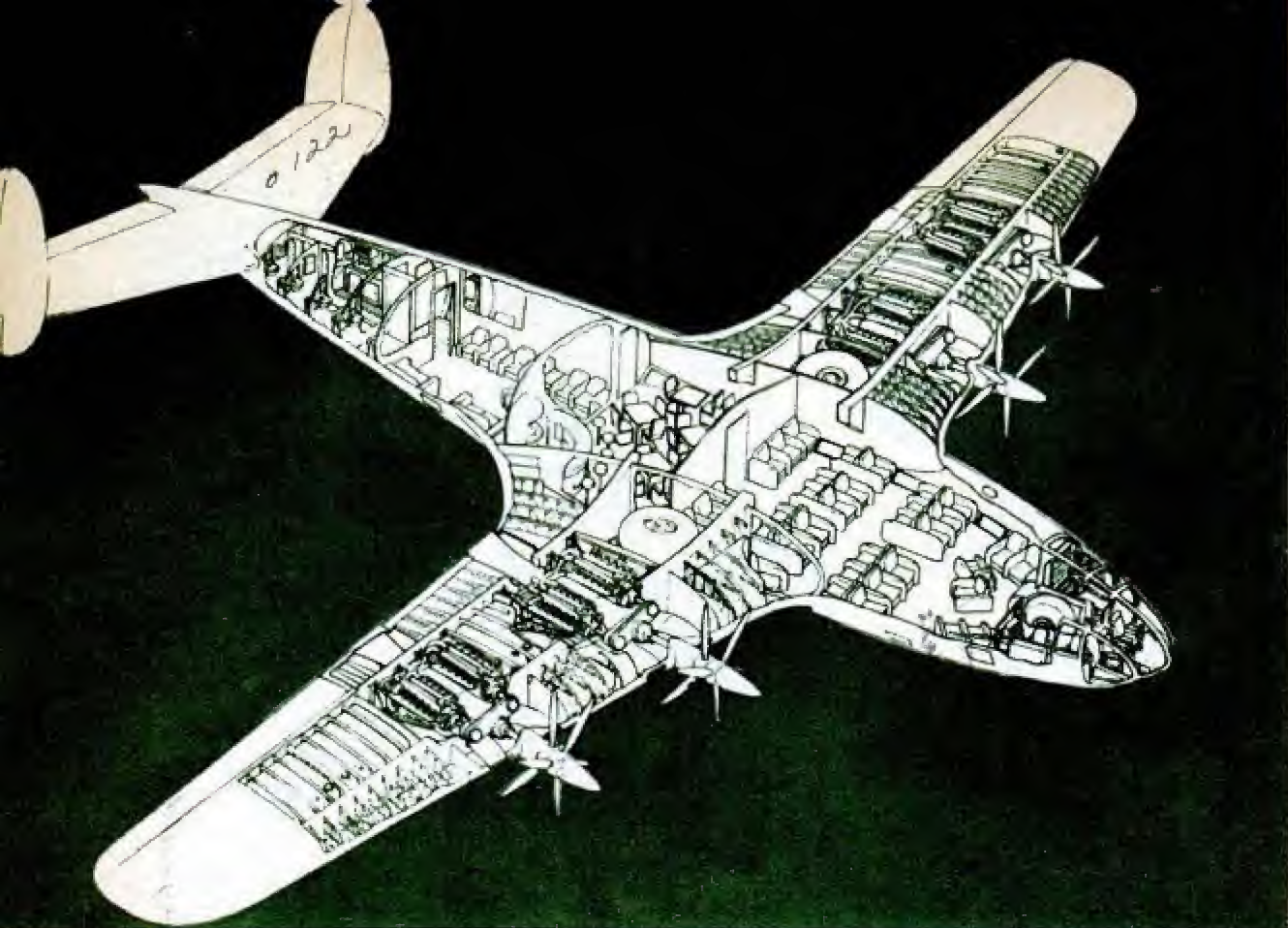
Our horse cavalry is not used as dramatically as the Russian Cossacks and Guardsmen, who struck the bewildered Germans swiftly from behind their own lines, killing and capturing almost entire infantry regiments. Because trained horses are adept at swimming rivers and hiding in ditches and woods, United States Army horse cavalry is considered valuable for scouting purposes in uneven country. Capt. Alvin T. Netterblad, who led a mechanized cavalry reconnaissance troop in Italy, said he often longed for horses on the devious mountain paths.

Many a patriotic horse is doing his bit by releasing a jeep for combat duty. In June, 1942, the army announced it was replacing 1,500 trucks and cars with animal drawn vehicles at camps in this country. In addition, coast guard sailors have been mounted on horses so they could cover more shore territory where saboteurs would be likely to land.

Stubborn, sure-footed mules made the headlines last March when they were

Continued to page 154





Eight-Engine, 55-Seat Plane to Have a 3,450-Mile Range

Plans for a postwar commercial airliner which will have eight engines and seats for 50 passengers and a crew of five have been drawn by a British designer, F. G. Miles. The plane is expected to attain a speed of 350 miles per hour and have a range of 3,450 miles. Payload for its maximum

range is set at 16,430 pounds. The design calls for Rolls-Royce motors producing 14,000 horsepower at 425 miles per hour at 16,000 feet, or, on a weak mixture, 10,000 horsepower at 380 miles per hour at 18,000 feet. According to the British Information Services, a scale model has been tested.



Rubber Bulb on Dusting Brush Blows Specks Off Lenses

Designed to remove the tiny specks which cannot be seen by the naked eye, a rubber blower bulb has been attached to a camel's-hair brush for use in cleaning lenses and film apertures of cine cameras and projectors. The blower roots out the infinitesimal particles from the lens or aperture when the bulb is squeezed, and the brush whisks them away.

Silver Coat Conducts Electricity On Glass or Wood Surface

Applying a ceramic type composition containing silver powder to glass, wood and other non-conductive materials gives the surface high electrical conductivity and low electrical resistance. The new composition, which is used in condensers and other units in electrical circuits, is applied by brushing, dipping, or spraying.



0124

Army Glider Can Carry a Fully-Loaded Truck

Although it costs only one-tenth as much as a transport plane, the YCG-13, newest glider of the army air forces troop carrier command, can carry almost as much as our heaviest bombers, and it is said to be ca-

pable of transporting more men and supplies in less time. The craft, which can land on its wheels or skids, is big enough to take aboard an entire medium truck, loaded with equipment.

Stabilizing Device on Helicopter Keeps Rotor Horizontal

0236



Regardless of the angle of the craft, a stabilizing device on the new Bell Aircraft helicopter keeps its rotor in a horizontal plane. The stabilizer, which is said to increase simplicity of controls, is placed between the mast and the rotor. The helicopter is powered by a 160-horsepower air-cooled engine mounted vertically behind the pilot's compartment, and uses a two-bladed rotor. Span of the rotor is 33 feet. On the tail is a conventional anti-torque propeller. Bell engineers believe their machine has hurdled three longtime obstacles in the development of helicopters—instability, excessive vibration, and difficulty of control.

*Bell Aircraft Corp.
Buffalo, N.Y.*

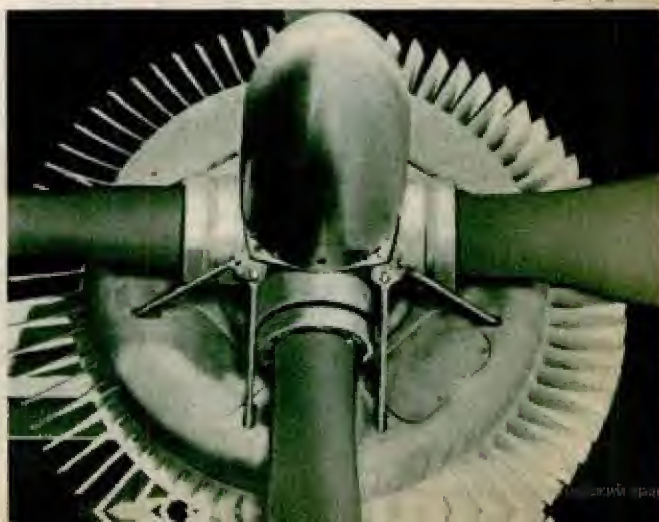
Cooling Fan Behind Propellers Steps Up Rate of Climb 20 Percent

0183

War planes can climb into the stratosphere 20 percent faster with a cooling fan mounted behind the propellers, according to tests conducted by the Wright Aeronautical Corp. The many-bladed fan developed by Wright engineers helps to eliminate the drag of earlier cooling methods. It is also said to add to the cruising speed and high altitude performance of war planes. Tests indicate that on twin-engined cargo planes the new cooling device can increase pay load 10,000 pounds. The fan fits just inside the engine cowlings and forces air over the engine's cooling fins.

AUGUST, 1944

Patterson M.J.



FIRE from the SKY



Above, fire bombs hurtle from B-17's to sow flames in Germany. Below, putting incendiary jelly in bombs



MATCHSTICKS are raining on Germany—matchsticks by the millions, matchsticks that leave a path of seared and ruined destruction, matchsticks whose flaring flame cannot be extinguished by any means known to man, matchsticks that are playing an important part in the Allied program of destroying the military might of the Axis.

These are real matchsticks, for they are used effectively and terribly to set fires, raging infernoes that raze enemy installations. They are known technically as incendiary bombs. Scientifically designed to burst into flame upon contact with almost any object, they range in size from two and four-pounders up to mighty 500-pound bombs which the experts declare will defy all efforts to extinguish them.

A bombing fleet can carry hundreds of thousands of the smaller incendiaries, a single large aircraft has a capacity of about 1,500. In a recent raid on Berlin's battered war plants, Allied aircraft dropped close to 350,000 fire-setting bombs. On that mission, the incendiaries made up almost the entire load of the air fleet, 98 percent, to be exact. In many situations, the incendiary

now pays greater dividends per pound of weight carried in bomb racks than does the high-explosive bomb, even the famed four and six-ton "block busters." As a result, the use of fire bombs has increased. When the war began, incendiaries formed only five percent of bomb loads carried by Allied aircraft; today the percentage is above 60 and is increasing steadily.

Production of fire bombs now ranges into the hundreds of millions, with seven principal types



Machine operator (above) corking the vents in magnesium incendiary bombs

of these bombs being employed against German and Japanese targets. For the most part, incendiaries are of the magnesium, thermate (Army version of thermit), phosphorus and oil varieties, largest being the extinguishing-defier, the 500-pound "block burner."

Of the seven types, the

Left, a demonstration of fire bombs. Below, a phosphorus bomb bursts, scattering particles



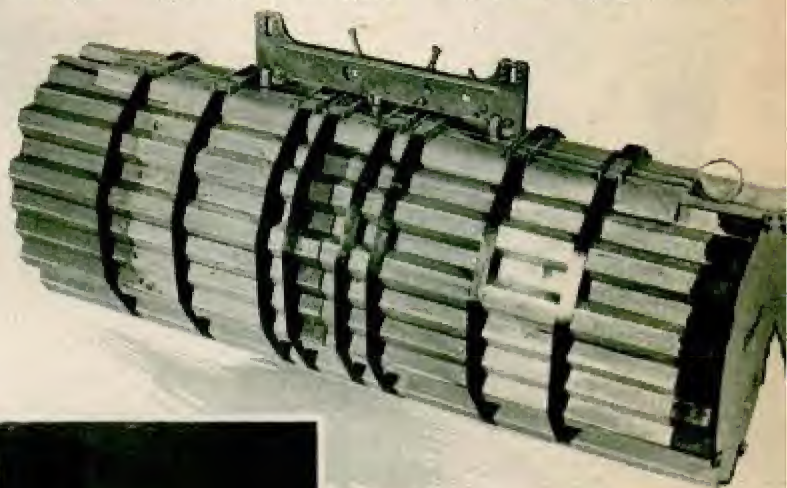


A stick of oil incendiary bombs falls toward the rail and communication center of Munster, Germany, as B-17's bomb bay doors open

magnesium bombs weigh two to four pounds each; usually released in clusters, they disperse to fall individually, like a handful of sparks dropping onto the carpet. They resemble giant metal firecrackers, but have a far more destructive nature than firecrackers. Although only one out of a dozen can be expected to land on something that will catch fire, their wide coverage—through the scattering effect—can start hundreds of small fires at the same time, vastly multiplying the difficulties of enemy fire-fighters.

Designed for use particularly against targets difficult to ignite, the four-pound thermate

The 100-pounder is a thin-walled shell weighing only 20 pounds when empty. It contains jellied oil which scatters in fiercely burning chunks over an area about 40 yards in diameter. Particles of the flaming oil cling to materials touched and resist efforts to extinguish. The M76, "goop" or



Right, a cluster of 500 fire bombs. Bomb printing press (below) speeds up labeling by doing away with stencils



PT bomb is the third, and largest—the 500-pounder—and contains a mixture of jellied oil, finely powdered scrap-magnesium and other ingredients. Experts claim that there is no known means of extinguishing it.

A 30-pound white phosphorus bomb, which contains 12 pounds of the agent, is somewhat similar to a fat cigar with a small propeller and a large steel fin. The phosphorus scat-

ters its clinging, burning particles over an area up to 100 yards in diameter. Suspended vertically in the bomb bay of an aircraft, the bomb falls free when released by the bombardier. Its propeller spins for several revolutions and then drops off, freeing the bomb fuse for action. This incendiary packs a powerful punch, but is lightweight and therefore must be dropped from relatively low altitudes to insure accuracy.

Clusters of fire bombs, upon being released from the bomb bay, break open automatically and spread packaged flame through space. Each cluster contains up to 128 of the four-pounders, resulting in a bomb that may weigh up to 500 pounds.

One of the latest developments in incendiaries is the aimable cluster, which has a nose and a tail as though it were a single bomb. This permits the lightweight bomb to be aimed with precision. At the proper altitude, a time fuse explodes a primacord charge and opens up the cluster.

Chemical Warfare Service, in addition to developing and manufacturing fire bombs, is responsible for testing the bombs as they come off production lines. At skip-bombing ranges fire bombs are dropped from low altitudes to strike a concrete mat almost horizontally and ricochet against a thick concrete wall.

The now famous Doolittle raid on Tokyo came at a time when the magnesium supply was very low in the United States, so the Chemical Warfare Service rushed into production a quantity of thermate bombs for this mission. Their effectiveness is attested by reports of the starting of hundreds of separate fires in the Japanese capital, fires which raged for many hours and destroyed vital enemy installations. Since that time, use of incendiaries has increased steadily and in one raid on Germany's shipyards at Kiel the fire bombs were employed, effectively and exclusively.

In the Steaua Roma company area of the Ploesti oil fields, the tanks were wiped out during the historic August, 1943, attack; every plane on that mission carried some fire bombs. Fifty-six tons of fire rained from the skies on Hamburg in the July 26, 1943, raid, while Schweinfurt felt the force of 80 tons on October 14, 1943, in the attack that virtually eliminated German roller bearing plants from further war activity.

The tremendous production of incendiaries by the Chemical Warfare Service indicates that some fire bombs are dropped in practically every attack. With the recent development of "block-burners," such as the 500-pound "goop," the trail of fire can be expected to leap with ever increasing momentum through enemy installations. There's fire in the skies over Germany—and Japan.



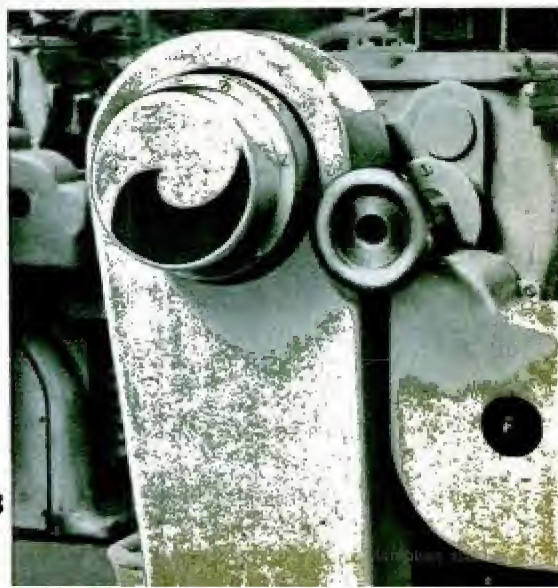
Propeller-Driven Water Scooter Hits 45 Miles Per Hour

Designed to look like a wingless sea-plane, a propeller-driven water scooter built by Herman Koplin, an employee of the Glenn L. Martin Co. at Baltimore, can travel 45 miles per hour. The boat's body, which resembles the front half of an airplane fuselage, has a cockpit and is mounted on twin pontoons that can be exchanged for skis in the winter. The craft is powered by a 27-horsepower, 4-cylinder, air-cooled motor and has two rudders, one on the rear of each float connected through pulleys to a control wheel in the cockpit. The gasoline tank holds eight gallons—enough for three hours.

*Baltimore 3, Md.
in A-30 and PB M
planes, Production Dept.*

Shaft Ends Turn in Red Spirals To Warn Passing Workers

Daubing the ends of revolving shafts with red paint is one of the many steps taken to reduce the number of casualties by the Air Service Command of the Army Air Forces in Oklahoma City, Okla. Shaft ends painted in this manner rotate in red spirals as a warning to passing workers to beware of danger.





Spring flood waters of the Sacramento break through levee in California's inland delta

TOPSY-TURVY FARMING



Houses on spongy peat soil are jacked up to keep floors level. Below, triple wheels on truck prevent sinking; all vehicles are specially equipped

AMERICA'S queerest farming region is below sea level and consists of ground that will burn if a fire is built on it and that will float downstream if its river banks are undercut.

"This Ground Will Burn" is the warning sign that cautions you against discarding lighted cigarettes. A crop can go up in smoke once a fire starts in the rich peat soil. Landowners sometimes take advantage of the inflammability of their ground to eradicate weed seeds and pests. They set the earth afire and burn off an inch or two of the surface, then flood the field to quench the fire.

That's one odd feature of the topsy-turvy farming practiced in California's inland delta at the confluence of the Sacramento and San Joaquin rivers, 50 miles inland from San Francisco Bay. Delta soil, one of the richest in the world, consists of silt and solid peat which in some spots is 40 feet deep. The region reaches from Sacramento to beyond Stockton. The delta was once a vast swamp or tule marsh, inundated by river waters and subjected to the rise and fall of ocean tides backing up the waters of the Sacramento.

During gold rush days a few



Mr. Hanson 0210

Swamp-type tracks with wide wood paddles attached support tractor on the loose soil



of the delta's marshy islands were reclaimed by hand-built levees. The surface water was drained off by opening drainage gates at low tide, also pumping by steam plants. Crops flourished so well that today 114 walled islands have been created, encompassing half a million acres of farmland that produce close to 50 million dollars worth of agricultural products per year. Some of the crops are grown on land that is 10 feet below the level of the water in the adjoining channels. Boats were the only means of transportation along the 550 miles of waterways until a decade or so ago. Now many of the islands contain paved roads and are connected by bridges. Free ferry service connects the others.

In the early days, delta farming was a continuous battle against fire and flood. Accidental fires in the dried soil did great damage,

Erecting emergency crest on levee to hold back flood waters. Below, chemical weeding rig sprays poison that kills broad-leaf weeds and drains harmlessly off narrow leaves of grain





This chunk of peat ground was set on fire with match. Farmers burn soil to destroy weed seeds. Sign (right) is familiar sight

necessitating flooding and re-pumping. Even controlled firing against weeds and pests has its drawbacks, for periodic burning of the surface has reduced the original levels of some islands by as much as five feet.

The first dikes that were raised were of light peat soil and when these were undercut by river currents a whole section of levee would float away downstream. When draglines were invented this machinery was used to drag up heavier silt to form more permanent levees. Seasonal combinations of high tides and high rivers are still an occasional threat to the islands, and

dredging and dike building is carried on much of the time.

Peat soil is a spongy mass of fibrous material. You sink in it over your ankles when you walk across it. Automobiles on the stabilized roads shake the ground like minor earthquakes. Trucks are equipped with three rear wheels on each side for support, with double wheels in front. In the days of horses, draft animals were shod with wide wooden shoes.

The modern track-laying tractor was invented in the delta region because of the need for buoyancy on the soft ground, and our modern earthmoving equipment like-

FIRE HAZARD
PEAT LAND WILL BURN
SMOKERS TAKE NOTICE
STATE DIVISION OF HIGHWAYS



wise got its start here. Delta farming is completely mechanized yet practically all mechanical equipment must be rebuilt for use in the area. An ordinary tractor would sink out of sight on a boggy patch of ground. Tractors must be equipped with extra-wide swamp-type tracks, over which wooden paddles are sometimes attached.

Because of the costs of drainage and levee maintenance it is most economical to farm delta lands in large acreages. This has permitted research that might not be profitable for owners of small farms. Thus the delta was one of the first areas to adopt chemical weeding. Broadleaf weeds that are a nuisance in narrow leaf crops, such as onions or grain are killed by chemical poisons that are absorbed by the weeds and drain off harmlessly from the narrow leaves of the crop itself.

Houses, barns, and sheds in the delta are all built above ground on short stilts. A house on an ordinary foundation would soon settle



Pipelines carry drainage waters from island up over levee into waterway beyond

out of plumb. Placing a house on stilts makes it easier to jack it for re-alignment.

Leaf lettuce grows three feet tall in the delta peat; watermelons grow so big that you can't get them through the door of an automobile, and pea vines put out pods that are a foot long. But the lettuce is no good, the watermelons aren't fit to eat, and there are no peas in the giant pods. These surface crops simply "blow up" and have no nourishment.

On the other hand, the delta lands produce several times the national average of potatoes per acre; sugar beets grow at the rate of 35 tons per acre, and the delta is the source of most of the asparagus grown in the United States. Root crops, corn, grains, and alfalfa flourish.

Delta farmers don't care whether it rains or not for they get all the water they want merely by opening flood gates or operating siphons that reach over the levees into the waterways. Irrigation ditches spread the water through the fields. Of more concern is the problem of excess water. Deep and narrow drainage ditches traverse the fields and conduct ground waters to central sumps where automatic float-controlled electric pumps discharge the water across the levees. This double system of water regulation permits close control of the water table in the ground. Ground moisture is raised or lowered at will to fit the needs of the different crops and the different stages of growth. In the delta, irrigation is mainly a matter of controlled drainage.

Being below sea level, the delta would be flooded by salty ocean water if it were not for the constant down-flow of river water. When the rivers are low, not enough fresh water comes down stream to prevent the ingress of salt water which is unfit for irrigation. The California state division of water resources measures the snowfall in the mountains each spring and estimates the month-by-month runoff. This is then interpreted into stream flow, which gives a prediction as to the time and amount of any salt water invasion. Warned ahead of time that sea water can be expected in the delta region during October, the farmers double their usual September irrigation to carry the crops through the following month in which they will not irrigate at all.

Demands for fresh river water upstream have lowered the flow of the Sacramento and the San Joaquin in recent years, allowing salt water to creep farther inland during periods of low river water. This condition threatened to make much of the delta unfit for agriculture, but now control dams have been built upstream. These hold back the spring flood waters and the excess is released during months of low water, insuring a safe minimum flow at all times.

Army "Knapsack" for Gas Holds Seven Gallons



Developed for carrying aviation gasoline over jungle trails or into zones where trucks cannot travel, is a water-resistant canvas bag which holds seven gallons. It has a strong, rubber-like plastic impregnated lining which withstands internal pressure and offers good resistance to heat and cold. The bag can be dropped and tossed around with less danger of bursting seams than with a metal container. Empty bags lie flat and require a minimum of shipping and storage space. When filled, the container weighs 50 pounds.

Penicillin Released to Civilians Will Cost \$35 Per Patient

In the near future, penicillin, the wonder drug which cures cases resistant to sulfa treatment, will be available to civilians according to Robert D. Coghill of the fermentation division of the Department of Agriculture. This is made possible by new methods which speed the growth of the mold from which the drug is derived. The estimated cost of penicillin for treating a severe case of blood poisoning is \$35. Twenty-one million dollar fermentation plants are now being erected in this country and Canada. Although the peak production of these plants will total only nine pounds of pure penicillin a day, this is sufficient to treat about 250,000 cases a month.

MODELS TEACH SAFETY



and demonstrated at safety meetings. As a note of comic relief, one model gets across a lesson on carelessness in which a workman and a bucket have a multiple catastrophe. The models were built by R. V. Milligan, safety inspector at Edgar Thomson Works, Carnegie-Illinois Steel Corporation. Mr. Milligan has found that in teaching safety rules, these equipment models combine many of the best instruction features of such single aids as charts, posters, graphs, movies—or even the real equipment itself.

With a flick of the controls on model crane, safety instructor shows foremen of steel mill how an accident occurred. Model has movable parts and is equipped with various types of safety devices. Below, model enacts comic scene to drive safety lesson home. First, descending bucket strikes "man" on head as he is climbing ladder; he falls as a foreman comes out of the door knocking the ladder on top of him

Courtesy U. S. Steel News

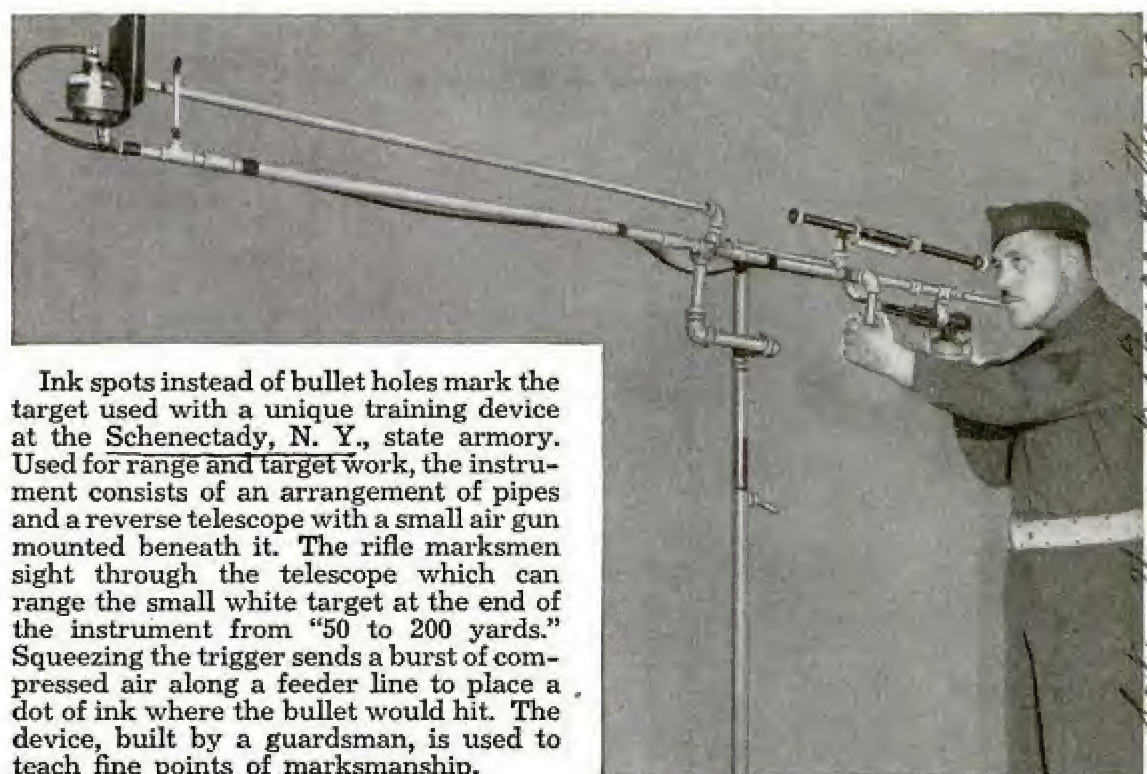


MODELS of equipment used in a steel plant, including a pint-size crane with movable parts, add realism to safety instruction by pointing out dangerous practices and re-enacting accidents. The overhead electric traveling crane has a hoist and bridge trolley which function like a real crane with the added help of a magnet. It is completely equipped with safety features including guards on moving parts, fire extinguishers painted the proper color, workable limit switch, warning signs and hand rails. When a new device is perfected, it is added to the model

48 *Edgar Thomson Works,
Carnegie-Illinois Steel Corp.
Carnegie Bldg., Pittsburgh 30,
Pa.*



"Bull's-Eye" Trainer Shoots Ink to Mark Hits



Ink spots instead of bullet holes mark the target used with a unique training device at the Schenectady, N. Y., state armory. Used for range and target work, the instrument consists of an arrangement of pipes and a reverse telescope with a small air gun mounted beneath it. The rifle marksmen sight through the telescope which can range the small white target at the end of the instrument from "50 to 200 yards." Squeezing the trigger sends a burst of compressed air along a feeder line to place a dot of ink where the bullet would hit. The device, built by a guardsman, is used to teach fine points of marksmanship.

Sp. Training Course of the N.Y. State Armory, 2nd Reg., N.Y. Guard

"Vest Pocket" Gasoline Furnace Heats 20-Room House

Although it weighs only 21 pounds, a "vest pocket" furnace now used by the armed forces can generate enough energy

to heat a 20-room house. About the size of an office waste basket, it uses the spiral accelerating flow design, is hermetically sealed and has a small combustion chamber. The gasoline-burning edition is being employed to dry soldiers' laundry, heat hospital tents, dry parachutes, de-ice planes and keep the ground warm while workmen dig tunnels. Engineers of the Stewart-Warner Corporation, which manufactures the heater, do not consider gasoline a good fuel for household use but believe the principles they have developed are applicable to the burning of fuel oil or manufactured or natural gas. They point out that the heater is so light it could be hung from the rafters of a house, or put in some other out-of-the-way spot, thus affording greater space for living. Smaller units, perhaps eight inches in diameter and nine inches high, could be supplied one to a room with individual thermostat controls.



Division at Walcott Chicago, Ill.

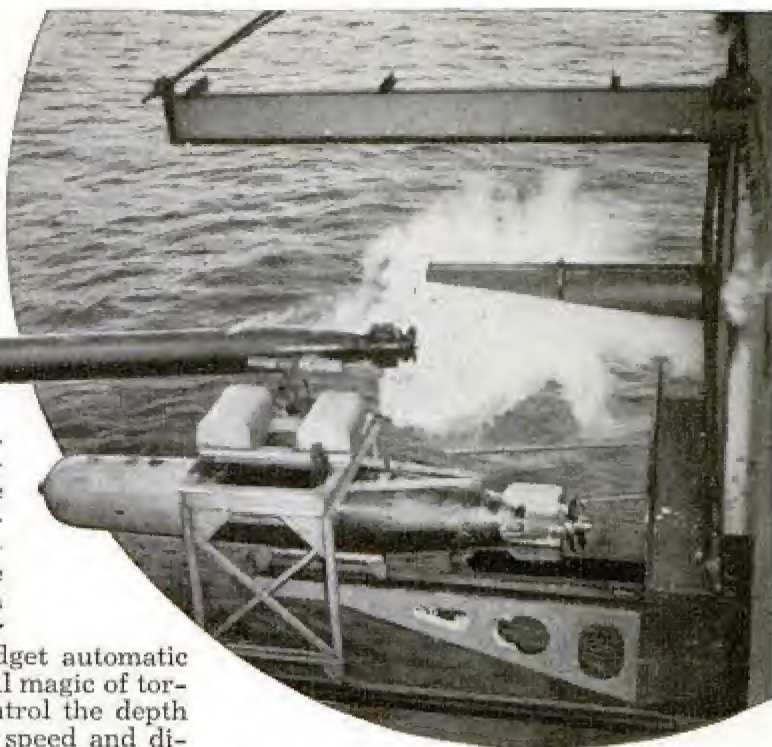
¶To learn where to buy commercial products described in these pages, see the index.

"hot, straight and normal" to blast the day-lights out of enemy ships.

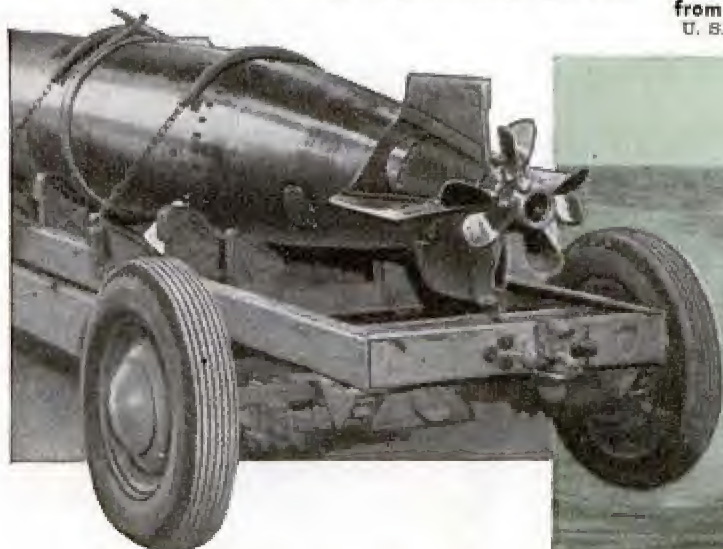
The trim little fishing cruisers and launches are still there, chasing these modern fish-of-war. But in addition, speeding planes, barges, machine shops, deep-sea divers and a great assembly of scientific instruments and Navy experts have a part in the fishing expeditions.

Few machines of war, regardless of their delicate adjustment, are more carefully put together than torpedoes. These cigar-like steel tubes, together with their complex interior mechanisms, are really midget automatic submarines. The mechanical magic of torpedoes enables them to control the depth at which they travel, their speed and direction, even shifting their course and moving around pre-determined curves.

Like submarines, they have propellers



Firing long destroyer-type torpedo from barge while aerial type beneath it awaits drop-test. Below, retrieving buoyant torpedo which will rise to surface from 18,000 feet after discharging water from head
U. S. Navy photos



and self-contained, self-regulated power plants. They are able to travel five miles at speeds around 50 miles per hour. Instead of firing a torpedo, the torpedoes fire themselves on contact with the target. Instead of carrying about 100 pounds of explosive, like a 16-inch shell weighing 2,000 pounds, they tote over 500 pounds of death-dealing TNT.

With all of the necessary devices tightly packed into their shells to make room for the big





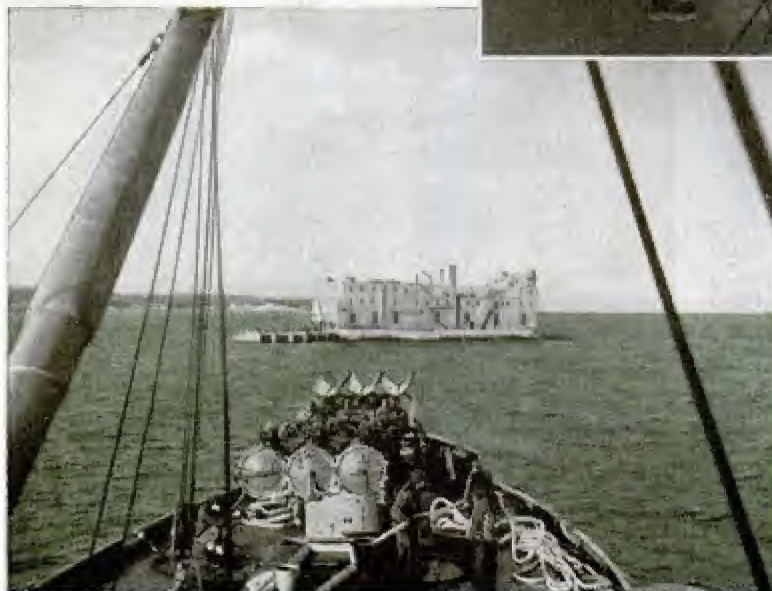
Loading the day's "catch" aboard Navy YTT after trial runs on range

explosive charge, even the finest workmanship and most rigid inspection are not sufficient to guarantee that, when the big moment comes, the tin fish will act precisely according to specifications.

So, when a torpedo has passed factory inspection, it is likely to be routed by way of New York City and along the length of Long Island to the tip, where the city's sportsmen once sought game fish.

Here, along with a number of others which appear to be duplicates, the torpedo is unloaded at what used to be the Long Island Railroad Station. It is now the

Right, torpedo has just been fired from tube on barge, full view of which is shown below. Note retriever boats left of craft



main gate house of the closely guarded area reserved for firing trials of tin fish.

The torpedo is trucked past a seven-story building used as officers' quarters, past the former fishermen's clubhouse built like a French chateau which now houses enlisted personnel and eventually to a pier. Here it is loaded onto a ship which takes it a few hundred yards out into Fort Pond Bay, where it is placed aboard what the Navy has named a YTT.

This 1,500-ton craft looks like a four-deck houseboat except that it has a number of torpedo tubes extending from a deck. It holds hundreds of torpedoes at one time and is the center of activity at the U. S. Naval Torpedo Testing Range.

While it is awaiting its test run, the tor-

pedo gets a thorough check-up. If the weather is cold, an anti-freeze solution is poured into its mechanism. At this stage, the torpedo is not equipped with its war head, the front section containing TNT. Instead, all are fitted with exercise heads, filled with water. If the weather is bad on the day scheduled for testing, the test is abandoned because high waves cause the tin fish to act up and a test under such conditions would be

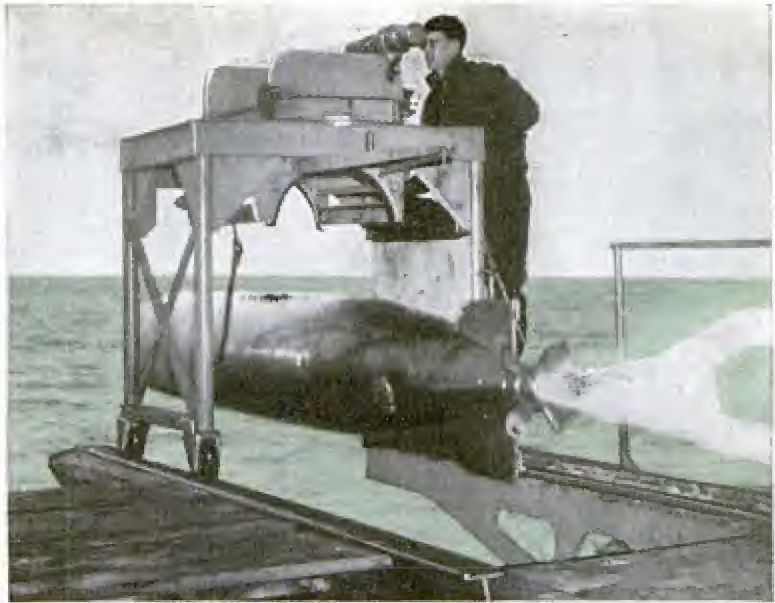
useless. There is never a dull moment on the range while firing is in progress. Target rafts are aligned for thousands of yards along the range and men in small boats clock the torpedoes as they flash by. A high-powered launch shoots away from the YTT each time a "fish" hits the water, accompanying it for the first few hundred yards, ready to follow if it goes astray.

Planes roar overhead. Their job is to track the "fish" and guide the retriever boats to the spot where the spent torpedo surfaces.

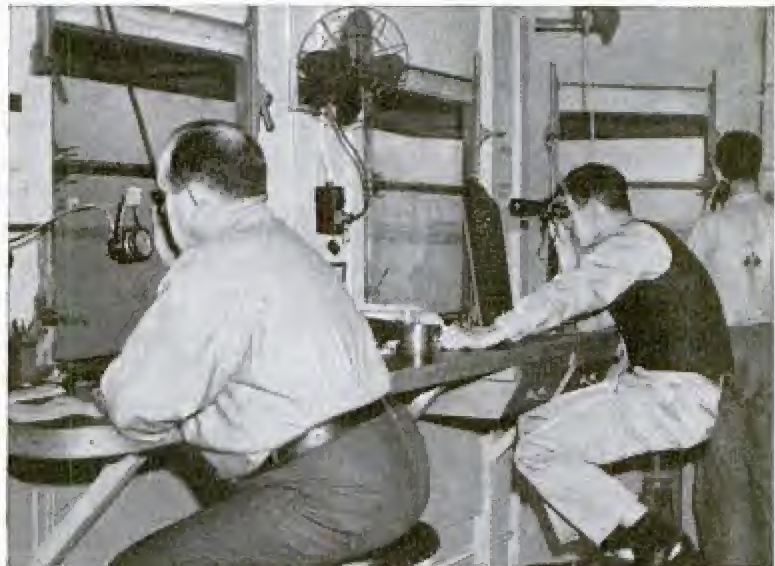
In the observation tower of the YTT a keen watch is kept. Radio-telephone contact with the small boats permits keeping a check on the torpedo down every foot of the course. With these engines of destruction costing about \$10,000 each, no chance is taken on losing one. Some go ashore, and men instantly go after them. Some sink, and the spot is marked so divers can retrieve them. More than a dozen divers work at the station.

Most "fish" cut a jug-handle curve before straightening out. The wake is clearly apparent.

Continued to page 148



Aerial-type torpedo starts test run with short drop from barge. One out of every five is also dropped from plane for double check on lot



In observation tower on barge, officer at left orders firing and man at right follows torpedoes with glasses as they speed down the range. Below, torpedoes ride odd conveyance along pier to boat



0129

Cow Is Cured of Pneumonia With Aid of Oxygen Tent



When a cow in Massachusetts failed to respond to food and developed a temperature of 106, a veterinarian diagnosed the illness as pneumonia and administered intravenous treatment of sulfa drugs. In 24 hours the cow showed no improvement, had difficulty in breathing and was unable to stand so the doctor devised an oxygen tent and put the animal's head in it. After oxygen was supplied for two days and sulfa drugs were administered at a rate of 1,080 grams daily, recovery resulted. This is believed to be the first time in which a cow was treated in that manner.

0177

Hose Clamp Tightens Like Belt To Keep Joint Leakproof



To effect a leak-proof joint, a hose clamp equipped with worm-and-worm gear action tightens like a belt. The tightening band is a spring steel strip perforated to correspond with the teeth of a worm gear. When the

worm thumb-screw is turned, the band is rapidly drawn through its housing to tighten the clamp. According to the manufacturer, the clamp does not require a lock wire to prevent its being loosened by vibration, since the beltlike action holds under extreme jolting.

067

Robot Monitors Warn Flyers If Radio Courses Shift

Warning signals from an automatic monitor are helping to prevent accidents which might result from the sudden shifting of radio courses being followed by transport planes throughout the United States. The monitor receiver is installed by the Civil Aeronautics Administration 1,200 feet from the radio range station, directly on the radio course, and connected by telephone line to an indicator panel in the airport control room. If any radio course deviates as little as 3 degrees from its normal setting, due to terrain or atmospheric conditions, the monitor sends an electrical impulse which flashes a red light and sounds a siren to warn the airport control crew. At the same time the airport monitor automatically dials the range transmitter which sends warning signals to all pilots.

0140

Spotters Wear Mine Markers On Their Steel Helmets

Mine spotters have created a new hat fashion by wearing their markers piled on top of their steel helmets while they range ahead of the army, seeking out the locations of enemy mines. Whenever they locate an explosive, they place a marker on the spot and the sappers, following the spotters, remove or demolish the mine.



Dr. Francis M. Austin
Palmer, Mass.

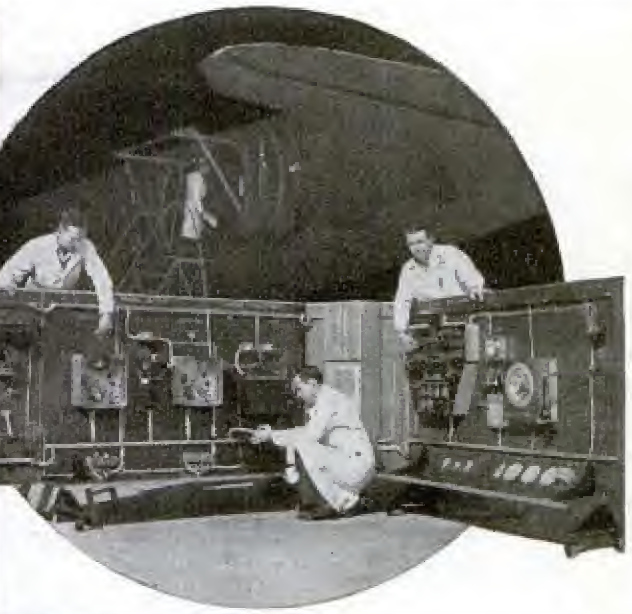
Delip Radio Mfg. Corp.

Delip, N. Y.

Jane Buerge of AAF Service School

0135

"Aircraft Carrier" on Wheels Trains Airmen



All intricate parts of the Douglas C-54 cargo ship from radio apparatus (above) to "Silent Joe" the automatic pilot (below) are carried in big boxes aboard two truck-towed trailers to help train maintenance mechanics, pilots, engineering officers and the flight crews at air depots



Checking electrical panels which are hinged to form square box to fit easily into trailer. The panels are on casters so they can be rolled into a hangar or classrooms

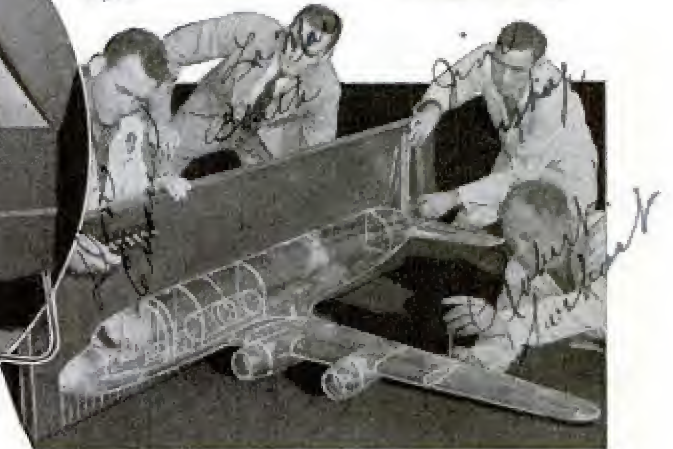
Left, trailer unit ready to "take-off" from Douglas Santa Monica plant. With unit go experts on engines, electrical equipment, radio, all parts of C-54

C. P. Pearson



Capt. Charles Mahan

Prize exhibit is model of Skymaster in Plexiglas. The switches operate lights at all the stations throughout ship

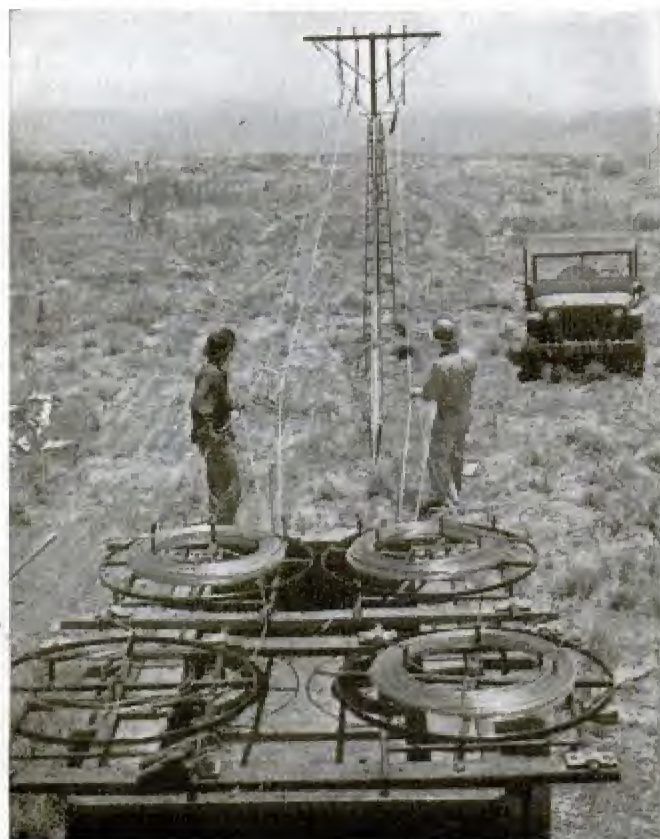


CALLING SIGNALS *for the* ARMY



Courtesy Electro-Voice Mfg. Co.

South Bend, Indiana
The "lip" microphone used by Army Ground Forces shuts out din of battle. It weighs less than two ounces. Below, Signal Corps men on trailer are erecting a telephone line overseas



THE most far-flung communication system in the world is one that relatively few people know anything about. Ten million words of traffic are transmitted over it every day. It employs every known method of communication from submarine cables to carrier pigeons and from radio to semaphore flags. It pries into the Arctic, crosses the equator, and circles the world.

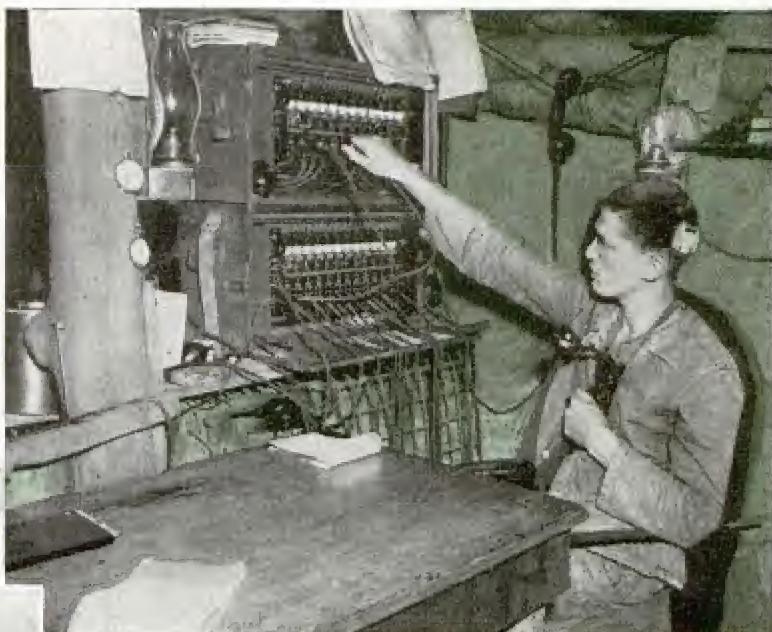
Called "A Com," it is the Army Communications System by which America's global war is run. Heart of the system is the Army Signal Center in Washington, D. C., and heart of the system's radio network is Station WAR, consisting of a number of radio transmitters near Washington.

These transmitters, beamed to other stations across the oceans, are of up to 40 kilowatts in power and are all remotely controlled by high-frequency radio circuits from the Signal Center. Voice, hand-keyed code, radio teletype, radiotype that handles 100 words per minute, and radio telephoto pictures are transmitted over them. Without such a system of high-speed communication our

global military operations would bog down and disintegrate.

Lesser stations are located in each military theater of operations and these in turn are the focal points of subsidiary radio and land wire networks. At the outer fringes of these webs the chain of communication reaches soldiers on the battle line. These men are in touch with their command posts by walkie-talkie or by handie-talkie radio sets.

Operating this great communication system is only one of the multitude



This telephone exchange in New Guinea is housed in a dugout and protected by sand bags. Left, scouts use radio to report to GHQ

of tasks performed by the Signal Corps. Members of the signal companies are among the first men ashore in an amphibious landing. Wire layers work right up to the front lines during battle, keeping communications open with the rear. Specially trained groups of signal men work with the cavalry, armored ground forces, and mountain troops. Signal radio intelligence men intercept enemy radio messages and by means of direction finders determine the locations of enemy stations so that they can be destroyed. Signal pigeon companies provide birds for carrying

Dogs transport carrier pigeons to front lines





Radio direction finder locates enemy transmitters for bombing

messages; other companies set up and operate the great trunks that connect busy military areas, while still other specialists repair battle damage to equipment.

An amphibious operation in particular is one that demands split second co-ordination between all elements. The only way to provide this is with hundreds of miles of telephone wire and with innumerable radio circuits. Amphibious two-and-a-half ton trucks carrying complete radio stations are

Under cover of smoke screen, Ranger uses handie-talkie to communicate with ship during beach operation



among the vehicles that reach shore early in such a landing. Wire for telephone circuits follows right behind, and jeeps or motorcycles for message carriers are also on "priority" during the landing.

The Signal Corps provides two-way radio sets for the cars of military police. It develops and supplies equipment for the Air Forces. It provides radiosonde apparatus for army weathermen, land mine detectors for the engineers, and has specialists who study captured enemy communication apparatus for possible ideas that we could use ourselves.

In this connection it is interesting to know that most German radio sets are well and ruggedly built but are poorly waterproofed. German broadcast receivers usually bear the warning: "Use of this radio for foreign station reception is a crime against the national safety. By order of Der Fuehrer such use will be punished by severest penalty. SOLDIERS, BEWARE!"

Jap radios are either direct copies of American sets or are of inferior construction. B batteries, tubes, and other units carry both American and Jap symbols for identification and the imitation even apes the colors used by manufacturers for distinguishing their products. Fabricated frames that are easily damaged or twisted, distorting the calibration, are used in place of castings.

More than 100,000 items ranging from

midget tubes to big mobile broadcasting stations are used by the Signal Corps or are distributed by it to the troops and the Air Forces. Even such incongruous items as porcelain eggs, poison gas, and blonde hair that has never been permanently waved are included in the Signal Corps inventory. The porcelain eggs are used to fool mature pigeons into laying real eggs to maintain the supply of message-carrying birds, while poison gas in tiny cylinders is included in each shipment of pigeon feed that is sent abroad. The gas, slowly escaping, kills vermin in the feed. Blonde hair has its use as the humidity indicator in radiosonde types of weather stations.

Practically all Army short and medium range voice radios are frequency modulated, this being a reason why you can pick up little Army traffic on your all-wave amplitude modulation receiver. FM was adopted because such circuits are difficult to jam, are least affected by man-made or natural static, have greater fidelity, and require less power. Experience of the military suggests that after the war, many commercial broadcast stations will switch over to FM. Some present broadcast receivers can be adapted to receiving such programs by means of a special tuner, while other home broadcast receivers will need to be replaced.

Army radio equipment is ruggedly built, for lives and battles could be lost if part of a set fails in a crisis. Early during re-armament a Signal Corps officer put a commercial police radio in a tank and took it for a ride. The radio shook to pieces and went out of operation within a mile, before the tank had a chance to fire its guns. The specially built radios used in tanks are able to operate perfectly

Continued to page 150



Signal Corps men using sturdy high-powered mobile transmitter



*Hollingsworth Co.
2611 Indiana St.
Chicago 16, Ill.*



Above, mobile radio station operated by gasoline-driven generator on trailer. Below, Signal Corps sets up army wire circuits in Italian ruins

Train Riders Are Measured To Find Perfect Seat



Above, chair which measured thousands of passengers

To find the ideal seat dimensions for postwar coaches, the Boston & Maine railroad recently set up a test chair in Boston's North Station concourse for the purpose of measuring 3,000 adult passengers. Working with the Department of Anthropology at Harvard University, the railroad will measure for correct seat height, seat length, elbow height, hip breadth, back height, and shoulder breadth. Results of the test will be made available to all railroads.

Planes Drop Self-Igniting Tanks To Set Enemy Fields Afire

Incendiary belly tanks jettisoned by fighter-plane pilots to set the enemy's fields afire now carry detonators which ignite them when they reach the target. Formerly, after the planes descended to grass-skimming altitude and dropped their tanks filled with gasoline and crude oil, they had to circle around and ignite them with incendiary bullets or small-caliber cannon shell. Another flame-thrower designed to frighten the Japs, who are said to have a special fear of fire weapons, holds

a fuel which includes a type of solid incendiary particles that make denser snow-flakes of fire within the general sheet of flame. These continue to burn after the rest of the flame has gone out. To rout an entrenched enemy the army sometimes puts white phosphorus in shells, bombs, mortar-missiles and hand grenades so that fragments of the flaming stuff fall in an arc-like shower, dropping vertically into slit trenches and fox holes and disabling their occupants with flesh burns.

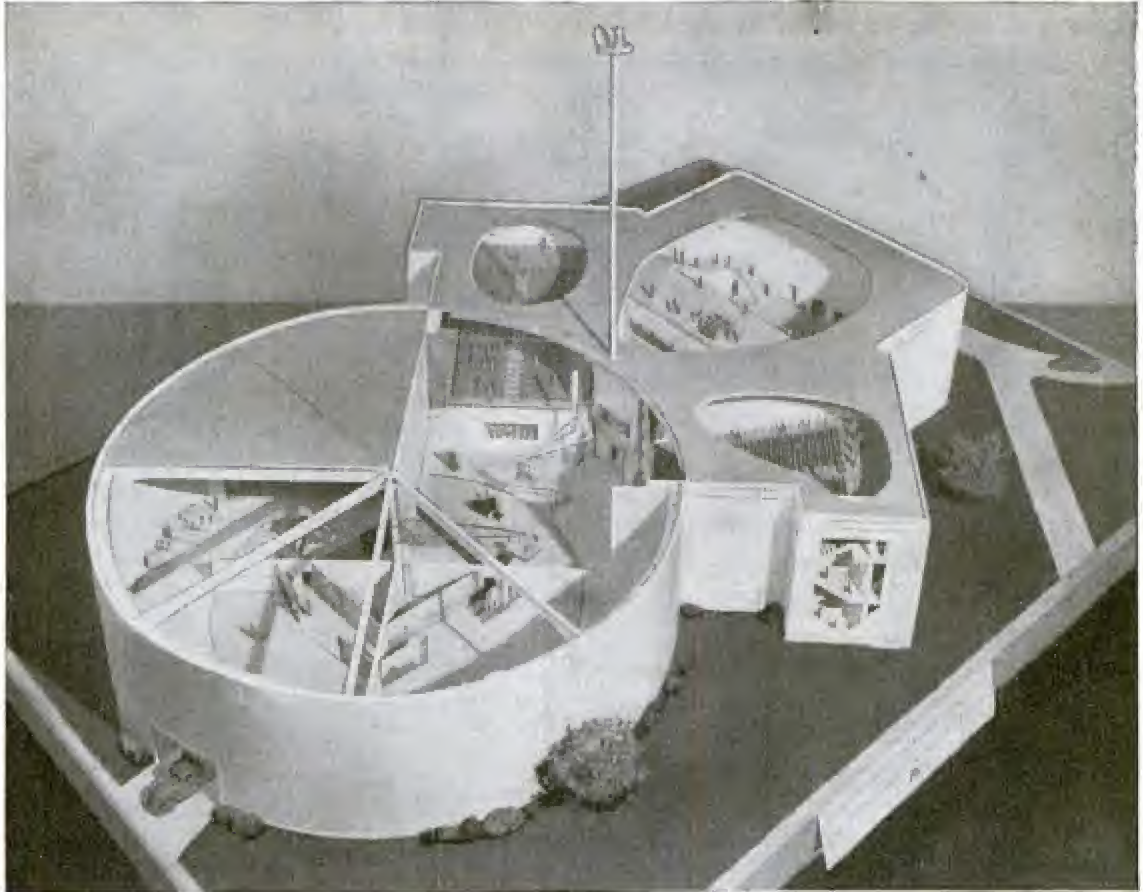
Hand Blinker Trains Air Crew To Signal Like Sailors

Cardboard blinker devices with shutters like those in regular Navy blinkers are used to train aviation cadets. This insures plane-to-plane or plane-to-ground communication should radios be destroyed by enemy action or when radio silence is necessary so position will not be revealed. The training blinker is operated with the pressure of a finger on the cardboard to simulate dots and dashes. The International Morse Code is printed on the back of each blinker which enables cadets to send messages before they have learned the entire code.



Army Air Force photo
Top, pressure operates shutter; bottom, reverse side

Rotating Stage for Television Has Four Sets



To provide for rapid change of scene without interference with telecasting, a working model of a postwar television studio exhibited recently includes a circular rotating stage with four sets. The auditorium part of the theater is divided into three sectors. The center part is occupied by the cameras, which are placed so they

can take the scene from any angle and all ranges. Flanking this are the sectors occupied by the studio audience. Soundproof curtains can cut either sector off from the stage at the end of a scene if it is desirable, so members of the audience could file out without disturbing the performers. Both sectors could also be used at once.

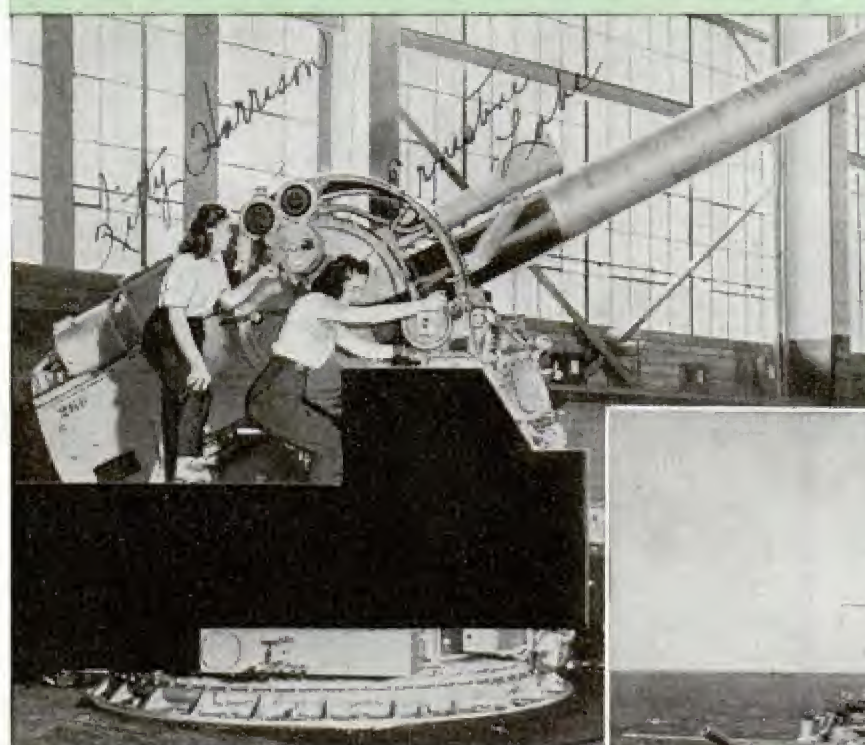
Army Sleeping Bag for Wounded Has a 20-Footer Zipper

To keep the wounded warm while evacuating them in cold climates or at high altitudes, a special army sleeping bag is equipped with two mattresses closed by means of a slide fastener more than 20 feet long—one of the longest zippers ever manufactured. In all, there are 10 separate zippers to permit access to the patient at any point on his body without entirely exposing him. Another slide fastener with three sliders permits opening the bag down the front.

Among 115,287 predatory animals destroyed last year in 29 states were 103,981 coyotes.



The ALL-AMERICAN GUN



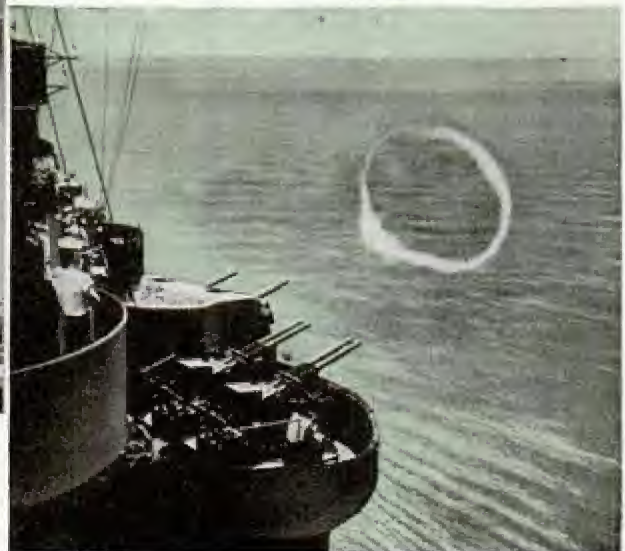
The Japs call it a giant machine gun, and our Navy men say it will do anything but shoot straight down. It is the Navy's 5-inch gun. Although many Allied weapons were developed by the best ordnance experts of several nations, this gun was produced by American designers for American ships and built solely in American arsenals. It is the main armament on destroyers and is also used on aircraft carriers and other important ships. Above, gun mount checkers making final inspection at naval ordnance plant



Five-inch guns guard flight deck of veteran U.S.S. Ranger, first Navy vessel designed as a carrier



Three 5-inch guns belch smoke during test at proving ground at Louisville Naval Ordnance Plant. New light cruiser tries out its guns (right) on target towed by vessel which is just a dot on the horizon



*Mr. C. N. Moore
1362 N. Dearborn St., Chicago 10, Ill.*



Direct hits by 5-inchers at Tarawa exploded Jap oil dump in cloud of black smoke. Gun is power-driven and fires 12 50-pound projectiles per minute. Upper right, target of armor plate throws up beacon as it repels shell during double purpose test at the Navy Ordnance Proving Ground, Dahlgren, Va. The horizontal range is 10 miles, ceiling six

Right, Marine gunners man 5-incher as antiaircraft weapon during actual combat aboard carrier. Gun has latest fire control and can be automatically or manually controlled. Power of projectile is so great that near hits, controlled by time fuses, knock out planes. Below, putting a mirror-like finish on barrel which is precisioned to 10,000th of inch



75-Foot Air-Conditioned Bus Crosses Desert

0182



Equipped with 12 gears, a monster **RAF** bus travels between Habbaniya, Iraq and Damascus, carrying 40 passengers with luggage. The vehicle, which weighs 30 tons, is 75 feet long and 11 feet wide and its wheels stand 4 feet, 2 inches high. Completely air-conditioned, it has a kitchen, toilet and taps which give ice water.

Bus, resembling a rubber-tired Pullman being drawn by truck, dwarfs sedan of conventional size beside it

Power Plow Guided by Hand Cleans 4-Foot Lane of Snow

0168

Powered by a five-horsepower, gasoline-driven motor, a snow plow guided by hand can clean any standard-width driveway in two quick sweeps. Its 48-inch blade is completely reversible as to angle without

changing a bolt, and it can be set straight for bull-dozer jobs. Resting on a pair of rubber-tired wheels, the plow is two feet high and can easily handle snow 14 inches deep, according to the manufacturer.



Engine Fueled Like Diesel Eliminates Throttle Lag

0197

Fuel is delivered directly to the cylinders of a gasoline engine instead of in vaporized form with a new injection method. Advantages of the system, developed by the American Bosch Corporation, Springfield, Mass., include smoother power delivery and the elimination of time lag on the throttle, higher efficiency with low-grade gasolines, and reduction of fire hazard. With this system, fuel is delivered uniformly to every cylinder and the smooth flow of power is said to increase mileage per gallon. Diesel engines are fueled much the same way. While present production is earmarked for military uses, the development is expected to have a wide effect on all kinds of gasoline-powered transportation after the war.



Mr. Stinson

UP IN Alaska it sometimes gets so cold that an ordinary gasoline-fired air heater spits icicles. Aircraft mechanics who are trying to warm an engine on the ground put three of the heaters in a row so that the warmed but still chilly air from the first heater passes through the others, picking up heat from each.

At high altitudes the cabin heater of an airplane labors against even lower temperatures. In fact, the air may be so thin and cold that the fuel used in the heater won't even ignite.

Thirty-five thousand feet, roughly, is the present practical ceiling at which men can exist, aircraft can fly, and equipment can operate. Greater altitudes have been reached, of course, but this is the generally accepted ceiling. Man wants to fly higher, say at 10 miles above the earth, and science is developing ways and means to make that possible.

Dressed in experimental high-altitude clothing, a gunner is tested for mental and physical reaction to telephoned commands in cold chamber. Below, on the comfortable side of the new Douglas stratosphere room an engineer operates altitude controls on main panel

025-





The stupefying effect of oxygen want and low pressure at high altitude is shown by flyer who could not finish sentence "I feel well"

Supercharging a cabin heater so that it will provide warmth in the stratosphere is one item. Furnishing adequate atmospheric pressure for the men is another. Even while breathing pure oxygen every flyer has his individual "ceiling" some-

dropped to a little less than one pound per square inch, comparable with that of the atmosphere at 65,000 feet.

In this frigid partial vacuum the Douglas engineers create a gale of thin wind by means of an external air circulation sys-

where in the neighborhood of 40,000 feet. Above that point the air is so thin that his blood doesn't absorb enough of the oxygen he inhales. Each breath must be taken by conscious effort instead of being an automatic reflex. But what is the best way to provide a denser atmosphere under military conditions? Should the whole cabin be supercharged or would it be simpler for each man to wear a helmet and suit inflated to comfortable pressure? Researchers are studying the problem.

Engine carburetion is equally important. At the Douglas Aircraft Company in California improved carburetor induction systems are being studied in a new big altitude chamber in which the low pressures and temperatures of the stratosphere can be duplicated. Inside the insulated steel cylinder, 10 by 40 feet in dimensions, temperatures as low as 130 degrees below zero can be attained while the air pressure is

From this switchboard, electricity of various cycles or voltages, a.c. or d.c., is fed to Douglas laboratories



tem. Just like the altitude chamber to which it is connected, this system is sealed and insulated against sea level conditions. The system even has special refrigeration to remove the small amount of heat that is built up in the thin air by the action of the fan blades that keep it in motion.

This strato-chamber makes it possible not only to expose carburetors and other aircraft equipment to the conditions found at high altitude, but to operate them just as if they were in an airplane moving through the thin air. Thus the complete air induction system may be studied while air and fuel are passing through it.

Another kind of stratosphere investigation has to do with guns. In Pennsylvania the York Corporation is building a double-roomed altitude chamber so that even ar-



Above, passing hot air gun through hatch in two-foot thick wall of cold room; inside temperature may be as low as 130 degrees below zero. At left, test board with 144 contacts for quick check of bomber's wiring circuits. On panel below are gauges for testing strains at 78 different points of airplane structure



tillery may be taken up to a simulated altitude of 50,000 feet. With an atmospheric pressure of 1.68 pounds per square inch and with the temperature touching 70 degrees below zero, shells from a 75-mm. cannon will be fired into a concrete backstop.

So vital has altitude research become that at Douglas two small strato-chambers in addition to the new big chamber are in operation. A great cold room in which the temperature may be reduced to 130 degrees below zero, and smaller insulated boxes inside of which the temperature can range from 160 degrees above zero to 130 degrees below, are also used. Seventy-five percent of the parts that go into Douglas combat and cargo planes have been tested in these facilities.



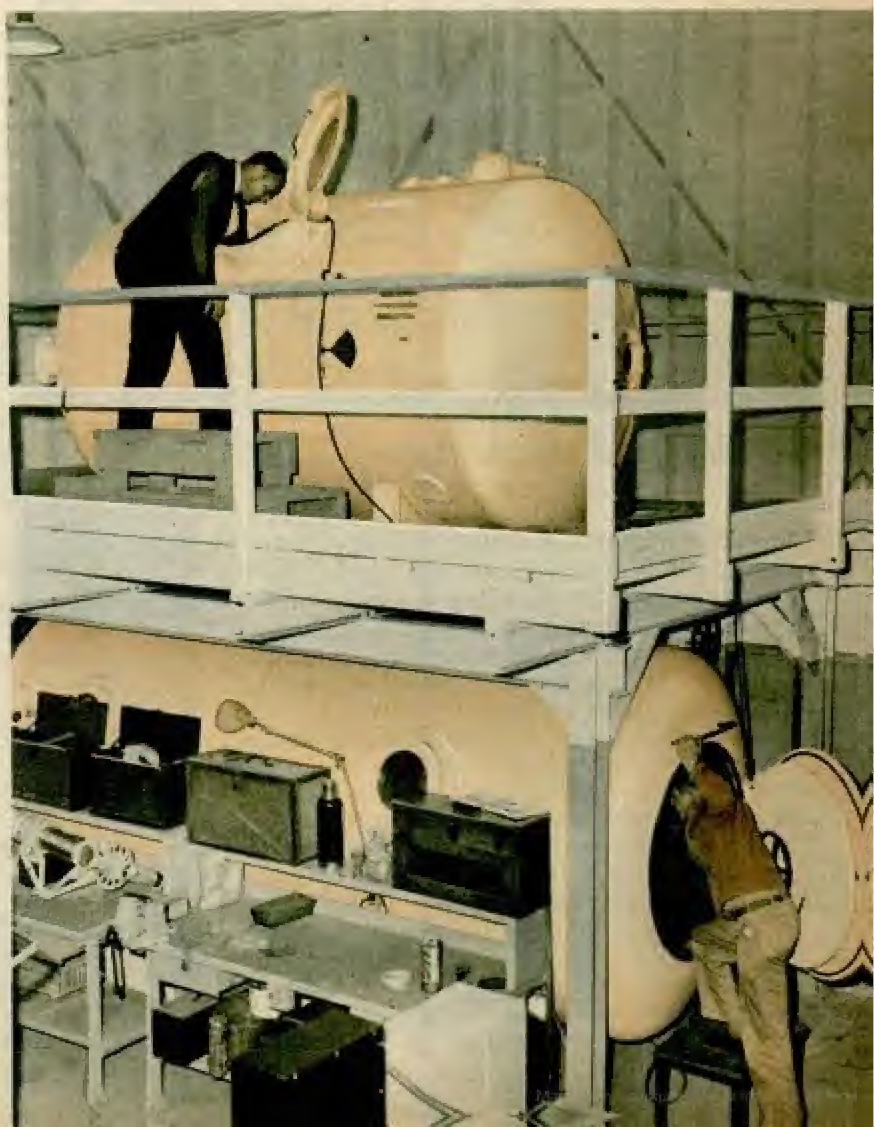


Testing an airplane radio with the help of dummy antennas in the radio laboratory, above. Two smaller altitude chambers at the Douglas factory are shown below. In these, men and materials can be put to test in "flights" under the conditions existing at 42,000 feet above sea level

sulted when the extreme cold of high altitude caused embrittlement of sealing compounds used in the tanks. New compounds that retain their elasticity at low temperatures solved that one.

Altitude investigation is only part of the research program at Douglas. More than 500 scientists, test engineers, and technicians under the direction of J. R. Goldstein are engaged in research, testing and improving the myriad materials and parts that make up modern aircraft. In one area, engineers are rolling a nose wheel down an incline, causing it to hit the ground with an impact similar to that of a hard landing. Electric strain gauges and a motion picture camera record the

Such studies revealed why the steel cables of an airplane's control system seemed to grow long and slack at high altitudes, why the double glass of cockpit windows bulged and gave distorted vision high above the earth, and why fuel tanks sometimes leaked at an airplane's ceiling. Control systems became slack because the steel in the cables shrunk less at low temperatures than did the aluminum of the fuselage, it was learned. Metals whose coefficients of contraction approach that of aluminum are now available as cables, providing positive control at all altitudes. The reason why the double windows bulged was because the dense air of sea level, trapped between the panes, expanded when the exterior pressures went down. Now the windows are vented or a pressure-equalizing device is used. Leaking fuel tanks re-



effect of the shock on the tire, wheel, and landing gear structure. Nearby, a new design of wing is being weighted down with tons of shot bags so that its deflections under different loads can be learned and its point of failure established. In an adjacent hydraulics laboratory a group is designing the hydraulic pressure system that will be used to operate a new wheel brake. In the radio lab a transmitter is being tuned on the bench so that no adjusting or shielding will be required when it is placed in an airplane.

Down in "Research Hollow" adjacent to the main Douglas plant, other investigations are being made. A maze of transparent plastic tubing, under a shed, duplicate of an airplane's fuel system, allows a group of fuel engineers to watch gasoline flow through the lines in response to the opening and closing of valves.

Vibration is an ever-present gremlin in aircraft. The constant shaking may weaken metal, rubber, or plastic to the breaking point. Parts in question are placed in mechanical vibrators that shake them for days or weeks at a time, then the parts are tested for strength. Whole portions of an airplane's structure, such as a huge engine nacelle with wing stubs at each side, complete to engine and propeller, are vibrated in a gale, hour after hour, in simulation of actual flight.

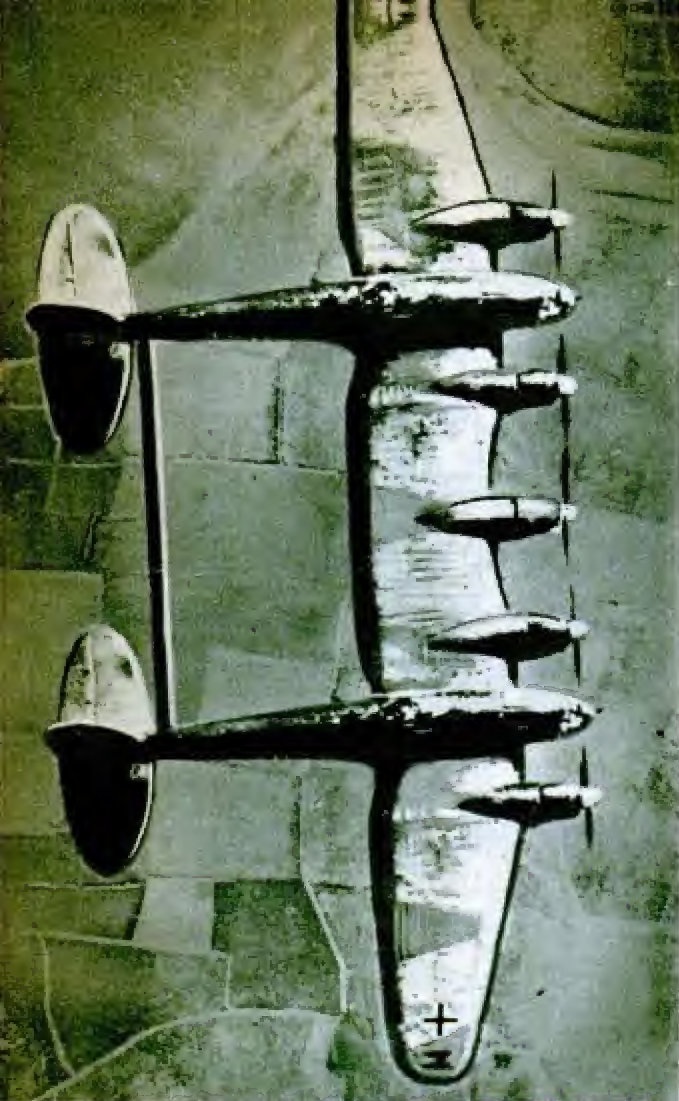
Year after year, such research enables our aircraft to fly faster, farther, higher, carry greater loads more safely, and last longer than ever before.

AUGUST, 1944



Landing gear in scene above has been undergoing a low-temperature test, and the technicians have to take it too. Below, a research technician emerges from Douglas "refrigerator" after a low-pressure instrument test





Two Heinkels Joined Together Become Nazi Glider Tug

When a Mosquito Intruder pilot recently shot down a German glider tug, called the "Siamese Twin" plane by the Allies, he said he could scarcely believe his eyes. It was a freakish looking craft consisting of two twin-engined Heinkels joined together at the wing tips with an extra engine at the joint. To give an idea of what it looks like, a composite photograph of two Heinkels attached at the wing tips was made, with a fifth motor sketched in.

Hearts Transplanted in Frogs Keep Pumping for 130 Days

By developing a method of rapidly sewing up blood vessels, a Russian scientist has successfully transplanted hearts in frogs. Some have lived for 130 days in the laboratories of the Gorky Medical Institute in Moscow. Electrocardiograms reveal no change in the muscle action of the transplanted organs and the frogs which were operated on behaved in a normal manner. The Russian scientist, Prof. N. P. Sinitsin, placed a second heart beside the animal's own in earlier experiments. Frogs with two hearts lived about 30 days. Later, frogs' hearts were completely replaced. Despite the success of the experiments, Prof. Sinitsin said the problem of transplantation of organs is still far from solved.

Russian

Gorky Medical Institute, Moscow

Mechanical "Lumberjack" Cuts 22-Inch Trees

Two huge blades which operate on the same principle as hedge shears are attached to a Caterpillar tractor to turn it into a mechanical lumberjack. The shears snip off a 17-inch pine or 22-inch elm in less than two minutes, and are said to do the work of 200 men. To cut a tree, the blades encircle the trunk, then close, and the tractor backs away. Patented by Kirk Knight, Jr., formerly of Bartlett, Texas, the machine was used for clearing ground on a dam project. Although production of the tree-shears was halted by the war, it is believed they might ease the manpower shortage in the woods and ultimately the paper shortage by cutting timber for pulp.

See the index to find where to buy articles described in this magazine. Say You Saw It in Popular Mechanics.



*O.A. Brewster
1507 College
Hartford, Conn.*

0263



Cut and Pasted "Wallflowers" Brighten Room

With a basin of water, a clean cloth and a yardstick, ready-pasted and cut floral appliques can be applied quickly to any plain, painted or papered surface. The decorations, available in six patterns of varied colors, include Victorian Floral for the living room, Lotus Pool for the bathroom, and English Ivy for kitchen, dinette, or sun room. Each pattern comes in seven pieces consisting of a centerpiece and six sections which can be arranged in bouquets, garlands or sprays. Before dipping them in water, they can be pinned to the wall for a trial effect and the top outlines marked with a pencil. As the paste does not set for several minutes, the inex-



*Pruney Co., Inc.
1012 S. Spaulding Ave.
Chicago 24, Ill.*

perienced home decorator can take his time. Cut-outs from the patterns may be used as accessory notes on screens, wastebaskets, or dresser drawers.

Paint Stripped From Windows by Coating With Solution



With the threat of enemy air raids steadily being minimized in the United States, a paint-stripping solution has been devised for those who want to remove blackout paint from windows and lights. Of heavy consistency, the paint remover can be brushed or sprayed on the windows without running over to adjacent surfaces. The stripper penetrates both asphaltic and non-asphaltic paints, and is said to loosen paint even on such surfaces as light bulbs, where the paint has been baked.

*Durco Products, Inc.
6135 S. Central Ave.
Los Angeles, Calif.*

Lt. (J.G.) Jones
4611 S. 31st Rd

AIR MADE



on earth right here in America, so is it theoretically possible to reproduce America's climate anywhere else in the world. Perhaps, in the coming years of peace, tourists to the dank islands of the South Pacific, where American bravery is driving back the Jap barbarians, may be able to put up at night, in temperate comfort, at an inn kept air-conditioned by some enterprising promoter of the tourist trade.

Air-conditioning is a double-barreled science; it aims at controlling the temperature and at clean-

Soldiers (left) "march" through different "climates" in army laboratory. Below, air conditioning keeps dust off these glass prisms used in making a war instrument

IMAGINE a smokeless Pittsburgh, or Gary, or Birmingham; smelter stacks in mountain communities without any trace of soot or fumes; homes where dust, or insects, or allergy-inducing pollens are unknown; temperate zone comfort at the equator...

These are some of the fancies conjured up by the developments in the science of air-conditioning which in two short decades has grown to occupy an indispensable spot in industry, and a position of high promise for the years after the war.

Just as it is now possible, in testing chambers, to reproduce any climate



Exterior 22 11/49
7 Arlington
Arlington, Va.

TO ORDER

ing the air itself. Though first conceived of as an aid to comfort, air conditioning is now recognized as an asset to health and bodily efficiency. Modern air conditioning is a far cry from early installations that were scarcely more than refrigerating units and frequently did not provide proper humidity, to say nothing of cleanliness.

If you ask an air-conditioning expert, "Can you condition the air in my home"—or office, or factory—like as not

Top, welding fumes and dust particles being drawn through hoses are removed by portable air cleaner. Right, a flip of the dial can cool this room in summer or heat it in spring or fall. Below, gears are cut in shop where the temperature remains constant for seven days



you'd get the answer: "Condition it for what?" So flexible are modern units that almost any variety of inside climate can be conjured up at will.

Clothing manufacturers, for instance, must protect their furs and woolsens from insects, yet prevent mold or mildew. Ideally, the temperature for the clothing should be 35 to 40 degrees, and the humidity high enough to prevent dry-



Navy parachutes hung in air-conditioned room to keep grit and moisture from damaging the fabric
Official U. S. Navy photo

ing of the fur skin. But this is not cold enough to kill moths, while the humidity is just right for them. With air-conditioning, periodic "shock treatments" are applied to the entire storage chamber. The temperature is rapidly lowered to 15 degrees, which kills the moths, then quickly raised to 50 degrees, to hatch out any re-



maining eggs, then again lowered to the killing temperature, and finally brought back to normal storage temperature. This same "shock cycle" is being employed to safeguard military clothing for high-altitude flying.

The tendency of silks to absorb moisture from the air, which changes their physical properties, makes air-conditioning essential in the making and storing of parachutes. Silks also tend to crack along the creases, when folded for any length of time, so the 'chutes are suspended, unfurled, from high ceilings, so that every square inch of the material would be subject to the ravages of excessive moisture were not the humidity properly controlled. Proper air-conditioning guarantees this control.

Not many Americans will go in for orchid-growing, but a great many might profit from the experiences of orchid growers in air conditioning. Theorizing that mold and bacteria ride "pick-a-back" on particles of dust, one firm installed an electrostatic air cleaner in its planting room, and anticipated an increase in the percentage of flowers from the orchid seeds, which take from 7 to 10 years to produce full blossoms.

But it isn't only the temperamental orchid that suffers from polluted air. Complete industrialization of the Western World has made soot almost the normal "diet" of the human lung. The average resident of an industrial city may take into his lungs each day a teaspoonful of dirt made up of particles so small they are usually invisible.

One analysis of this universal contamination showed the pollution to include 45 percent smoke carbons, or soot; 40 percent silicious matter, or windblown dirt; and the balance coal dust, fibrous matter, and other miscellaneous filth. In terms of excess laundering, dry cleaning, painting, metal-working and lighting costs, this air-borne pollution may cost merchants of a city, as well as householders, from 5 to 30 million dollars a year.

For more than a century it has been known that passing smoke through an electrical field simply makes the smoke disappear; Sir Oliver Lodge first applied this principle to the stack of a lead smelter in 1884; the Cottrell system was the first attempt to commercialize an electrostatic cleaner.

One such modern electrostatic cleaner is

High voltage electricity in these cells "electrocutes" dirt, dust and smoke, the enemies of precision work. The cells can clean 45,000 cubic feet of air a minute

Van Products Co.
Eric Trust Bldg.
Cire, Pa.

Foot Pedal Operates Vise With Air Pressure

0230



With a power unit that uses air to do the work of straining muscles, an ordinary bench vise is converted to a speedy machine tool. Slight pressure of the toe on a foot pedal closes the jaws of the vise under pressure up to two and a half tons, and heel pressure on the pedal opens the jaws as easily. The hands of the worker are free. Air control is provided by a cylinder attached to the body of the vise, and a pressure regulator permits handling of delicate parts as well as heavy pieces. The operator is protected by a safety stop. This unit is adaptable to 4-inch or 4½-inch vises.

0225

Glucose Substitutes for Water On Life Rafts Adrift

Castaways on rubber life rafts would stay alive longer if they had a supply of glucose, a common sugar which serves as both food and drink, according to studies made by Dr. James Gamble, of Harvard University. Dr. Gamble said that for every 100 grams of glucose eaten the body retains 140 grams of water which otherwise is excreted. In the experiments the glucose consumed as a partial substitute for water kept the men cheerful and physically active, while those who took no sugar were gloomy and dispirited.

the Westinghouse "Precipitron." It simply electrocutes dust particles. Fine tungsten wires are suspended in the leading edge of a cell, and at the outer sides of these is a grounded rod. Current of 13,000 volts, d.c., is applied between wire and rod, creating a strong electrostatic field, through which, as the air passes, every particle of foreign matter receives a positive charge. In the cell's collector are parallel plates, charged with 6,000 volts, and since unlike charges attract, the positively charged particles of soot, dust and the like are hurled to the negative plates, grounded and held, while the clean air passes on.

Such an air-cleaner has almost as many uses as there are industries. It keeps dust motes out of rooms where delicate radio, navigation, or fire-control instruments are being assembled; a spot of dust on parts of such instruments, or excessive moisture, might mean a miss for an American battlewagon, or for a Yank bomber; it might mean a navigating error that would bring death to the entire crew of an airplane.

Air-conditioning equipment of the Carrier Co. is being used in laboratories developing microfilm, where the tiniest particle of dust might obscure a whole word on the film. In welding operations, the "misting" caused by the heat of the torch, and the accumulation of fumes, are prevented by use of a welding fume remover, which sucks off the air from the operation, precipitates the tiny particles, then whisks clean air back into the operator's room.

Dust is a hazard to both men and machinery. With men, it can cause dread silicosis, asthma, or allergic skin troubles; with equipment, it can discolor plastics, foul lubricants, erode cylinder walls, cause short circuits or fires in electrical equipment, or even violent dust explosions.

Fine dust discharged from a 300-foot stack, can travel 276 miles before sinking to the ground, and the finer the dust, in some cases, the greater its possible damage to the lungs.

The air-conditioning of hospital operating rooms has become almost a "must," for a supply of clean, dust-free air minimizes the danger of infection, and the same equipment also whisks away the fumes of anaesthetics that might otherwise decrease the efficiency of medical teams. Such equipment is being installed in portable operating chambers and laboratories for the military services in the field.

The nerve center of any airport, its radio control tower, is almost always completely unprotected from the sun, and with glassed-in walls to assure a clear view of the runways for the operator, charged with dispatching the landing and departing

Continued on page 152

FIGHTING BELOW THE WATER LINE

By Thomas E. Stimson, Jr.



Sailor closing overhead valve in a warship's engine room. Below, port between engine rooms is closed during battle to make compartments watertight, and orders are given by phone



A WARSHIP is no better than the "black gang" that mans its engines, and its chances of victory in a sea fight depend to a great degree on the coolness and resourcefulness of these men who fight from below the water line.

From their battle stations the firemen and engineers have the double duty of operating the engines and, in case of damage, making emergency repairs so that the ship can continue to fight.

Not only does their power plant propel the ship itself but from it comes the energy that raises ammunition from the magazines, moves the deck turrets, and helps load and fire the guns. The black gang provides power for the steering engines, it keeps pressure on the fire mains and operates the ship's pumps, and it even distills fresh water from the sea for drinking purposes and for the boilers. Without these men the ship is helpless.

Ordinarily the power plant consists of several firerooms in which steam is manufactured, and several engine rooms in which this steam operates turbines that are geared to the propeller shafts. Cross connections make it possible to pipe steam from any fire-room to any engine room, enabling the ship to keep moving even though part of the plant is knocked out. Similarly, the turbo-generators that create electricity are scattered through the engine spaces. Even if some of them go out of action, power to operate the ship's auxiliaries can be obtained from generators at other locations.

This technical strategy plus the heroism of engineers and firemen in repairing battle damage at the risk and at the cost of their lives is a reason why our ships are often able to continue to fight after be-



ing seriously hurt and why a crippled ship can often make its way to port for repairs.

When a ship goes into action the bridge is apt to ring for full speed on all engines. This signal is received by the throttlemaster in each engine room. He in turn rings up on his fire-room indicator an order for more steam. Then over the telephone that connects him with the bridge he learns the exact speed that must be made. "Make turns for twenty-eight



Above, yeoman relaying orders to engineroom from the bridge. Damage control man (left) wears self-containing breathing mask and carries hose with spray nozzle



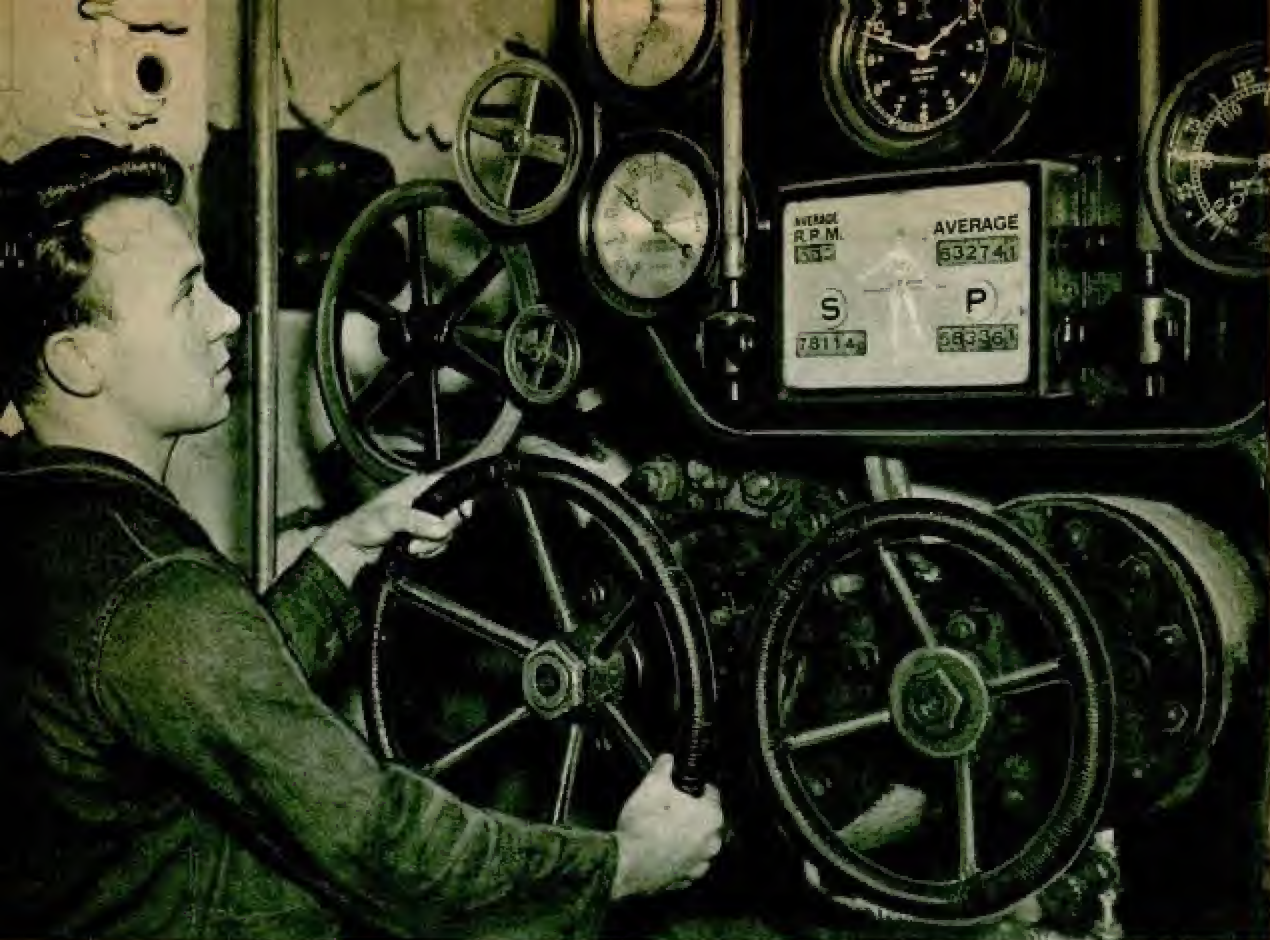
knots." He spins open his throttle wheel, admitting more steam to the high pressure turbine and increasing the rotation of the propeller shaft. The usual engine room noises increase in intensity and the big reduction gears begin to emit a scream that beats in the ears.

In the firerooms, meanwhile, the water tenders have ordered more burners lighted in the boilers to increase the amount of heat and so provide more steam. Blower speeds are built up to draw in more air for combustion. Here, too, the noise increases. The roar of the blowers and the rush of air through the boiler registers make even shouted conversation difficult. At slow speeds the firerooms are the hottest places on a ship and the temperature in front of the boilers may approach 120 degrees, but the temperature drops when the speed is stepped up. The increased flow of air reduces the heat.

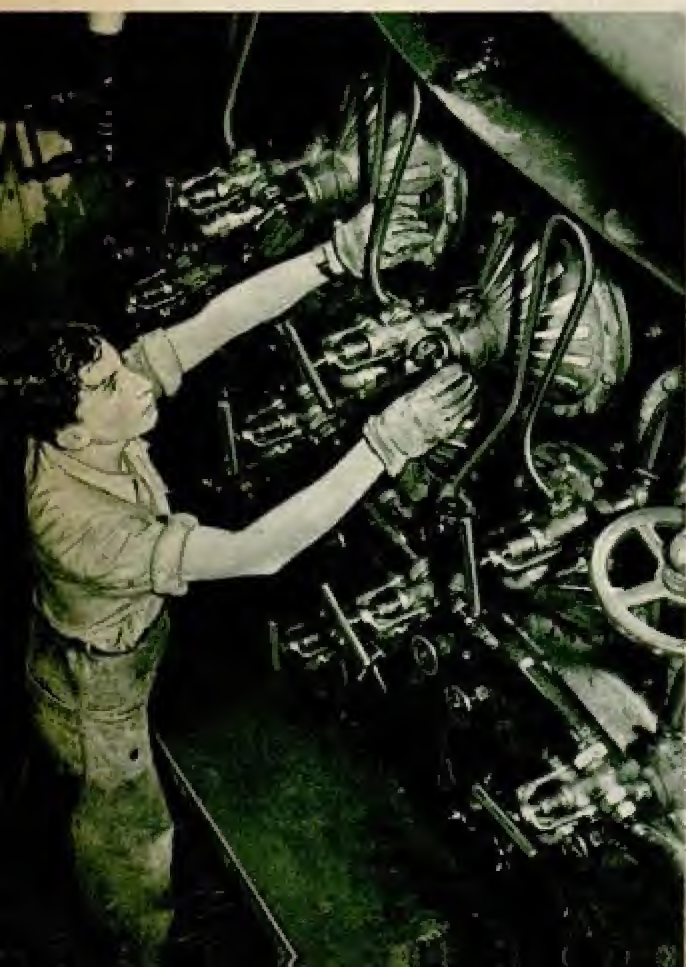
Some firerooms operate at greater than atmospheric pressure to provide forced

The U.S.S. North Carolina, new battleship whose underwater power plant is protected by armor and blisters
U. S. Navy photo





A throttleman, above, at controls of the turbines that drive a destroyer. Below, a fireman adjusting registers of express-type boilers in the fireroom



draft. These must be entered through an air lock, closing one door or hatch behind you before opening the second to avoid reducing the air pressure.

In such firerooms the water tender motions his men to stand clear of the boiler fronts when the ship goes into action. The firing of a big gun on deck can cause a flareback, drawing flames out of the boilers and badly burning anyone who stands in front of them. Such a flareback results from the partial vacuum that is created momentarily on deck when a gun is fired, starving the blowers of the air they are sending down. Too, the concussion wave from the gun's explosion blocks the gases that are rising in the stack, contributing to the flareback. The exploding of an enemy shell or bomb on deck can also pull the flames out from the boilers, and the piercing of the fireroom by a shell is bound to do so.

All sorts of damage can be caused by the punishment that a ship takes in action. The snapping of a fuel line can flood the bilges with oil, paving the way for a disastrous fire. A leak in a fuel tank, allowing water to mix with the oil, puts the boiler out of action when the water reaches the burners. The tank must be shut off, the lines and burners cleaned out, and a switch made to another tank.

The water that the boilers heat into steam is much more pure than ordinary

drinking water. Even a slight contamination can slow down the ship. It doesn't take long, if salt water mixes with the boiler water, for the salt to make its way to the turbines and collect on the blades, locking them and putting the engine out of action.

A leak in one of the lines that carry superheated steam at high pressure can be a bad casualty. The deadly vapor may kill every man in the compartment at one breath. Nothing can be done until one or two damage control men, dressed in asbestos suits and breathing their own self-contained oxygen supplies, descend into the compartment and shut down the leaking steam line.

One of the many epics of the black gangs in this war occurred while the Japs still held a foothold in the Aleutians. In the North Pacific an American force of four destroyers, a light cruiser, and a heavy cruiser was jumped by a Jap force that consisted of six destroyers, two light cruisers, and two heavy cruisers. By all the rules of war our ships were doomed.

During the three and a half hour gunnery duel the American heavy cruiser was hit hard several times and it was her engine room gang that kept her in the fight. One shell pierced an oil tank, letting loose a flood of fuel oil and ice cold sea water that began to fill an engine room. The men stuffed rags and their own clothes into the cracks of the leaking bulkhead without effect. The engine was shut down and the

Continued to page 154

High pressure turbine (below) in the engine room where the "black gang" sweats it out in battle



Young destroyer men (above), off watch, relax in their crowded quarters. Below, damage control man puts on asbestos suit before beginning his task

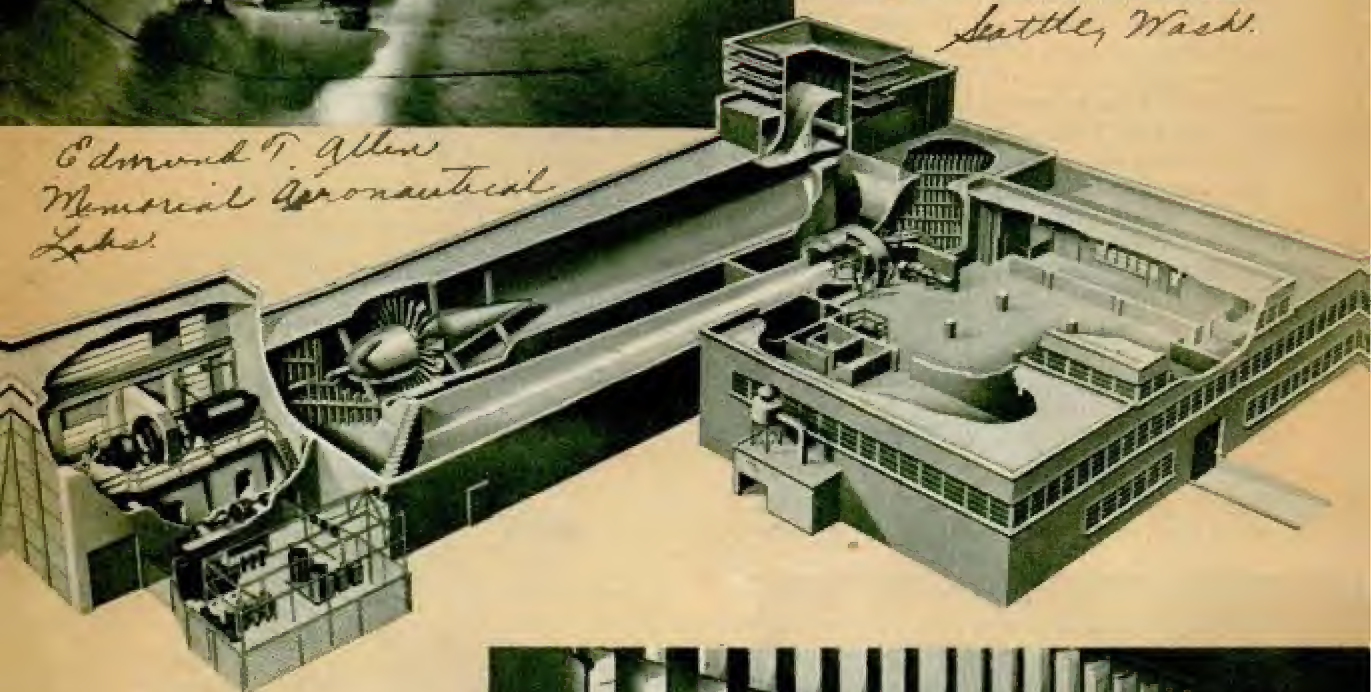


HARNESSING the HURRICANE

Aircraft models can "fly" 700 miles per hour—almost the speed of sound—when engineers turn on the giant 16-blade fan (left) in the Boeing Aircraft Company's new wind tunnel. The "hurricane" stirred up by the fan, powered by an 18,000 horsepower motor, runs the 450-foot rectangular course in less than two seconds. Models up to 12 feet in width can be tested

Seattle, Wash.

*Edmond T. Allen
Memorial Aeronautical
Lab.*



Cutaway shows power substation, engine room, the tunnel bore, air interchanger tower and operations room. Conical shaped fairing extending from hub of fan prevents turbulence. Test model can be seen in narrow "throat" of tunnel



High banks of vanes (right) guide wind smoothly around four corners of the tunnel. The vanes not only serve to "turn" the air, but also cool it during high speed operation. They are hollow and enclose sprays of cold water



Gun Launches Plane With Blank Shell

Firing a blank shell, a catapult gun half as large as a man provides the power to launch scout planes from the deck of a battleship or cruiser. When a shell containing black powder is fired in the gun, the rapidly expanding gases rush into a bomb-shaped expan-



Clifford Freeman



Above, shell is put in catapult gun to test breech. Left, officer watches as workman tries an inspection gauge on line of catapult guns in a plant

sion chamber and operate a large piston, just as gasoline vapors explode to push the piston in an automobile engine. The piston yanks a small cart along the catapult track at high speed, and the scout plane, sitting on the cart, is projected into the air.

0130

"Village" Loaded on 12 Barges Floats Down Ohio River

Thirty fully equipped homes loaded on a string of 12 barges were pushed by a tug down the Ohio river from Pt. Pleasant, W. Va., to Uniontown, Ky., where they were unloaded for Camp Breckenridge, Ky. Because the river rose, then fell, then

rose again, it took three weeks to load the tow. The houses were 24 feet wide, 56 feet long, and 15 feet high. Two barges lashed together made a separate unit, which had room enough for five houses. The tow was made up of six of these units.



The houses, looking like a couple of blocks uprooted from a small town, are pushed down the Ohio river

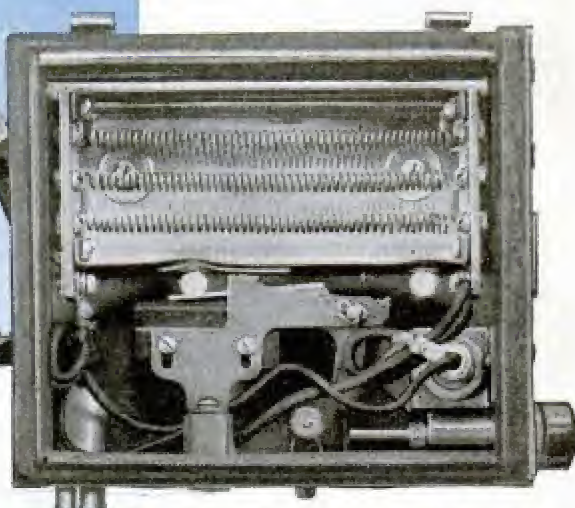
CAMERAS *at* WORK



THE little black box that you used to record junior's first step has been promoted to one of the prime tools of industry and science.

A six-ton camera that, for all its enormity, is still a first cousin of your pushbutton miniature, is on the day and night shifts at Boeing turning out patterns for big bombers. In another industrial theater the drop-lets of fuel sprayed from a Diesel engine injector perform for ten-millionths of a second before the critical eye of an engineer's camera.

Before an audience of



Studebaker engineer attaches "muff" to movie camera to overcome poor shutter action in sub-zero. Its heating coils are shown at right. Below, a cameraman at a Bell Aircraft plant rides the nose of an Airacobra like a cowboy to make a technical shot for the engineers; assistant holds light



medical scientists a human eye looms up to fill a seven-foot projection screen, and the sutures used in a delicate operation appear the size of a ship's hawsers. Factory workers watch on another screen the sequence of photographs training them in the most efficient method of packing aircraft parts.

If you have been irritated at times by the shortage of film and supplies for your pocket camera, you will be comforted by the knowledge that photography in its multiple phases—visual training, research, micrography, photo-tem-

Mr. Grant

Bell Aircraft Co.
2049 Commonwealth Ave.
Buffalo, N. Y.



plate work, motion study and vibration analysis, down to simple things like V-mail and "passport" photos for war workers—has developed tremendously in technique and in importance during the war. Without the camera as its "seeing eye," American industry that has astonished the world and itself by its production pace would have been as handicapped as the blind.

The home of the Airacobra is a typical example of industry's dependence on photography. Neither the largest nor the least important photolaboratory, Bell Aircraft's studio turns out 10,000 photographic prints a week, and the number has been as high as 13,245.

Visual training is one of the most important functions. Thousands of "green" workers had to be trained in a brief period. The plant photographer caught the sequence of a process on 35-millimeter film, enlarged the prints, and the supervisor placed the pictures before the new employee. It was easier to learn how to install the hood over the pilot's cockpit from pic-

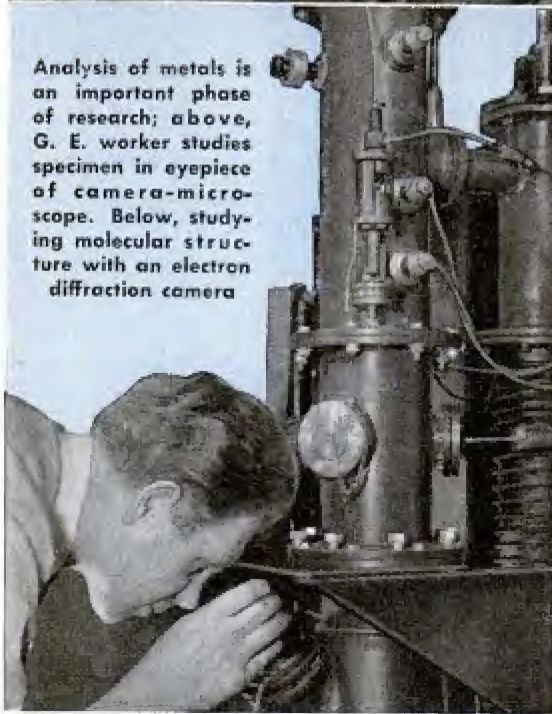
Developing and enlarging prints on the night shift at the Bell Aircraft photo darkroom. Below, a metallographic expert at Schenectady plant of General Electric Company photographs metal sample



Mrs. Constance Bordin



Analysis of metals is an important phase of research; above, G. E. worker studies specimen in eyepiece of camera-microscope. Below, studying molecular structure with an electron diffraction camera



Westinghouse photo

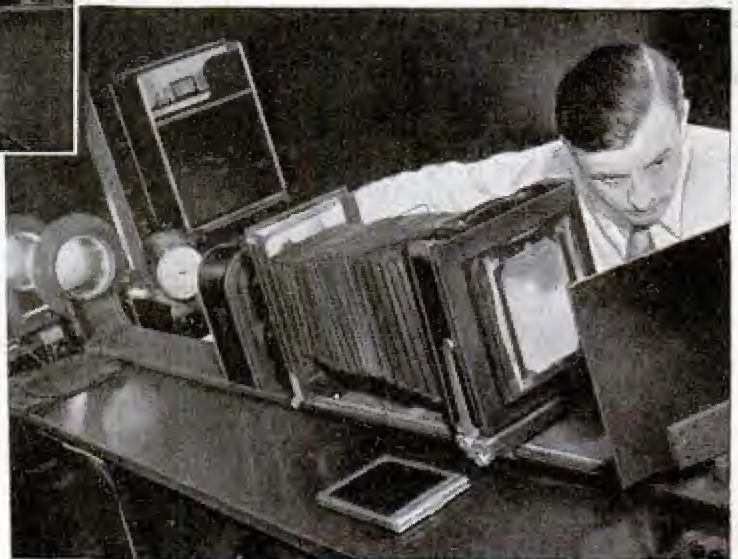
tures than from hours of lectures or textbook study.

Bell's movie division has produced at least 30 sound films illustrating production and maintenance and flight of the P-39. Various other sections of the laboratory handle employee identification pictures, X-ray photography, micrography, publicity pictures, record photographs on microfilm and so on. Company records are also copied on paper

negatives, which permit quick contact printing and save film.

Microfilm recording has become almost an industry in itself. Many large companies, libraries and government offices have adopted the miniature film to save a vast amount of warehouse space devoted to valuable documents. General Electric puts accounting records on film, recording as many as 8,000 filing cards on a roll of microfilm the size of a package of cigarettes. In Los Angeles the 33,000 400-page volumes of maps, records and deeds accumulated in the county recorder's office

A Westinghouse engineer uses polarized-light camera to picture inside of plastic models of turbine parts



since 1852 have been transferred to more than 85 miles of micro-film which occupy only three percent of the storage space required by the original documents. Over 7,000,000 exposures were made during the transfer.

High-speed motion pictures and stop-motion "stills" have become vital laboratory instruments. One of the newest cameras, developed by the Bell Telephone laboratories, is capable of exposing 8,000 movie frames per second, using 8-millimeter film, or 4,000 frames on 16-millimeter film. Projected at the normal 16 frames per second, this 8,000-frame movie magnifies time by 500 to 1. At top speed the film travels through the camera at 70 miles an hour, expo-



Above, laboratory staff at Bell Aircraft plans a studio picture. At left, Boeing's template chief compares his pocket camera with six-ton camera for making templates

sure time per frame being as rapid as $1/30,000$ of a second.

Henry M. Lester of New York, a specialist in the high-speed art, is a regular consultant on industrial problems involving vibration and high-velocity machine operations, and photographs surgical operations and kindred work for the medical profession. He tells of taking a half day to set up a truckload of equipment; then making the complete exposure in $1\frac{1}{2}$ second. He made a photographic study of an airplane propeller, set in motion by sonic vibrations, and revealed "fishtail" vibrations along the blade, enabling the aeronautical designers to correct the trouble.

The Hercules Powder Company uses millionth-of-a-second pictures to analyze what happens when a high explosive detonates. Wright Aeronautical engineers focus the speed cameras through a quartz window to observe what happens inside an airplane engine cylinder.



Special hand bracket (top and right) holding photofloods and 35-millimeter camera, was designed by Bell Aircraft for use on visual training picture assignments. Below, North American Aviation uses X-ray to activate fluorescent coating on metal template in this housing. Metal glows except where lines are scribed



General Electric's contribution to speed photography is a portable lamp which throws a millionth-second light of sufficient intensity to "stop" for the camera a wheel rotating at 70,000 r.p.m. Its tiny mercury lamp, about as big as a wooden match, will burn only one full second—but it's good for 1,000,000 exposures and at that rate would last the average newspaper photographer 500 years.

With the Edgerton stroboscopic lamp, which flashes on and off hundreds of thousands of times per second, a fascinating study is being made of the buzzing wing beats of tiny fruit flies, in order to determine photographically the effect of drugs and other phys-

iological stimuli on these insects.

One of the greatest time-saving achievements of the industrial camera is the photo-template process, most dramatically seen in the big aircraft plants. Every airplane part requires a full-size pattern or template, and the Boeing Flying Fortress, for example, has some 30,000 parts. Before the photo-template method arrived, each template was laboriously laid out by hand from a conventional blueprint—some requiring 200 hours of individual work. Today the photographic process produces for Boeing in 48 man hours what formerly cost 12,000 man hours. Hundreds of copies of the template can be made from one photographic negative.

Boeing's engineers lay out their original drawing on a sheet of thin steel, the drawing being the exact dimensions of the part to be produced. This master layout is

placed on a huge easel in the photo template darkroom and photographed by the \$20,000, six-ton "big berth" camera. The glass negative, about one-fifth the size of the original drawing, is then used—with the big camera now as enlarger—to print full-sized templates on photosensitized steel plates. Some of these templates weigh as much as 300 pounds and must be hoisted by power crane from the easel to the 360-gallon developing tanks.

At the North American Aviation plant, the metal template is treated with a fluorescent lacquer, the master design is imposed with a scribing tool, and then under an X-ray lamp the drawing stands out as black lines against the fluorescent surface. A negative is made from this plate.

Photography has become the most effective of teachers. Inexperienced workers build ships in the Norfolk Navy Yard by following simple pictures instead of blueprints. After the first destroyer escort was built, photographers assembled about 200 pictures of every section of the ship and these were posted in their proper places in every subsequent "D.E." built, to guide the unskilled workman.

General Electric made high-speed movies of metal boring and cutting tools in action to learn correct cutting angles, and teach students proper technique. Many an arc welder learned his art from General Electric's full-color sound movie, "The Inside of Arc Welding."

A wartime innovation which makes possible motion picture "shooting" in sub-zero weather resulted from trouble encountered by Studebaker engineers in testing military equipment in the Canadian Rockies. Movies of the tests proved jerky because of poor shutter action when the cold contracted the camera's metal parts. Studebaker researchers designed a jacket to fit over the camera slide cover, enclosing heater coils fed by a battery and controlled by a thermostat. The camera functions efficiently now at 45 below zero.

Infrared photography, metallography, X-ray studies are all vital phases of industrial research, only now coming into full use. Color film is just a decade old, and is already indispensable. When the end of the war brings secrets into the open, there will be revelations of new color films and new uses of them. One company is understood to have under development a method of producing natural color pictures from black-and-white negatives.

Picture magazines have helped to teach industry that one picture is the equal of 10,000 words. Let the shipyard worker or manufacturer or research scientist ask a question—the camera will give him the answer.

AUGUST, 1944

Tractor With "Square Wheels" Offers Better Grip on Earth



To achieve a better grip on the earth, a tractor shown at a demonstration of labor-saving machinery by the Washington State College Extension Service was equipped with treads which squared off its wheels. Its inventor, R. N. Riblet, of Spokane, Wash., said the wheels offer exceptional traction and make the tractor bumpless.

Braille Marks on Phone Dial 0216 Help the Blind Make Calls

To help the blind patients at the Letterman General Hospital in San Francisco, Calif., in overcoming their handicap, a Braille telephone set has been devised. The phone has a portable dial mounted on a Bakelite encasement with the Braille alphabet and Braille markings for numerals on its face and back.



*N. A. De Stefano
219 Grindel Rd.
San Carlos, Calif.*

Radio Mast of Tubular Plywood Speeds Assembly at Front

Portable radio masts of tubular plywood are set up quickly at captured airfields to establish ground-to-plane communication. The lightweight masts, 50- or 75-foot models, consist of four sections four inches in diameter and a top piece which are joined by sleeve couplings. They were designed by the Signal Corps for easy "packaging" in cargo planes. A three-man crew can put the sections together, raise the mast



Lightweight mast supports man's weight; wires hold it erect

by a boom, and have a radio in operation in 30 minutes. The base end is set in a hinged metal socket fixed to the ground by long spikes. Guy wires help hold the mast erect. Formerly, heavy masts of solid wood or metal were used which were cumbersome to handle. The plywood masts have been widely used since proving their worth in the African invasion.

Bomber Engines 'Breathe' Under 'Brain's' Control

Long a secret, the Electronic Turbo Regulator was presented to the public recently as the instrument by which the Army Air Force controls the "breathing" of heavy bomber engines in high altitudes. The mechanism relieves the pilot of watching for over-speeding of the supercharger, which could prove fatal, and insures maximum safe power out-

put and efficiency. Employing the same basic circuits as the autopilot, its principle is to compress the rarefied air of the upper atmosphere and feed this to the carburetor under a pressure sufficient to obtain the high power output required of aircraft engines. It operates from a single knob control on the cockpit throttle column. This adjustment controls all four engines at the same time, assuring equal manifold pressure and providing a simplified control of air speed on bombing runs. The control system operates continuously, making minute adjustments in waste gas position as the airplane gains or loses altitude or speed, or moves into hot or cold fronts where air pressures vary. The Turbo Regulator also includes a governor, directly connected to the turbine, which automatically prevents the supercharger from overspeeding by setting up an electrical high limit, thus preventing the system from demanding more from the supercharger than it is capable of delivering safely.

0126

10-Barreled Nazi Mortars Toss Heavy Barrage

One of the many heavy weapons the German Army has rushed to the eastern front to try to slow the Russian advance is a motorized, 10-barreled mortar. Pictures from neutral sources which show several of these guns in action seem to indicate the Nazi gunners can fire 10 shells at a clip.

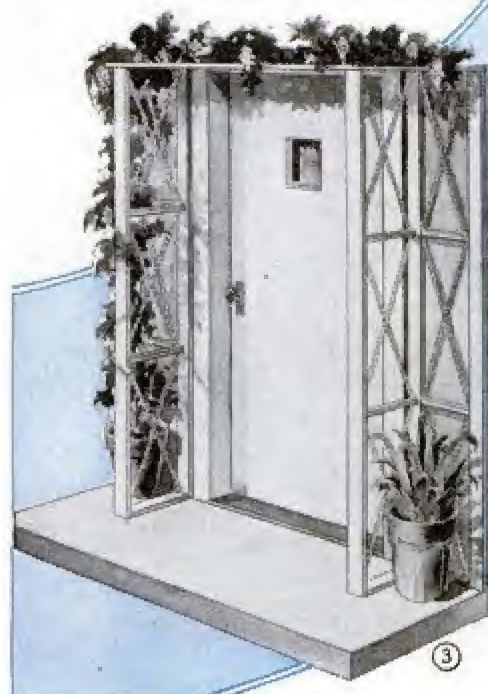
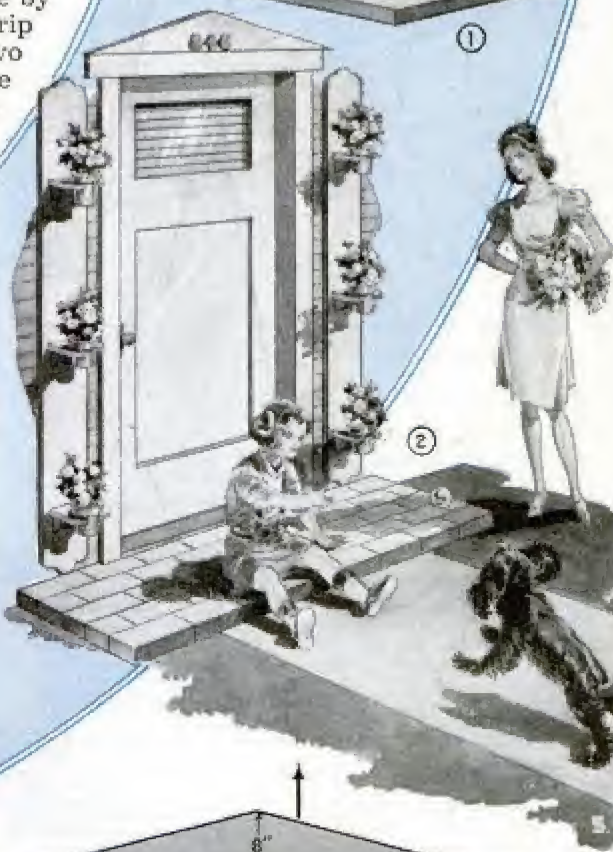


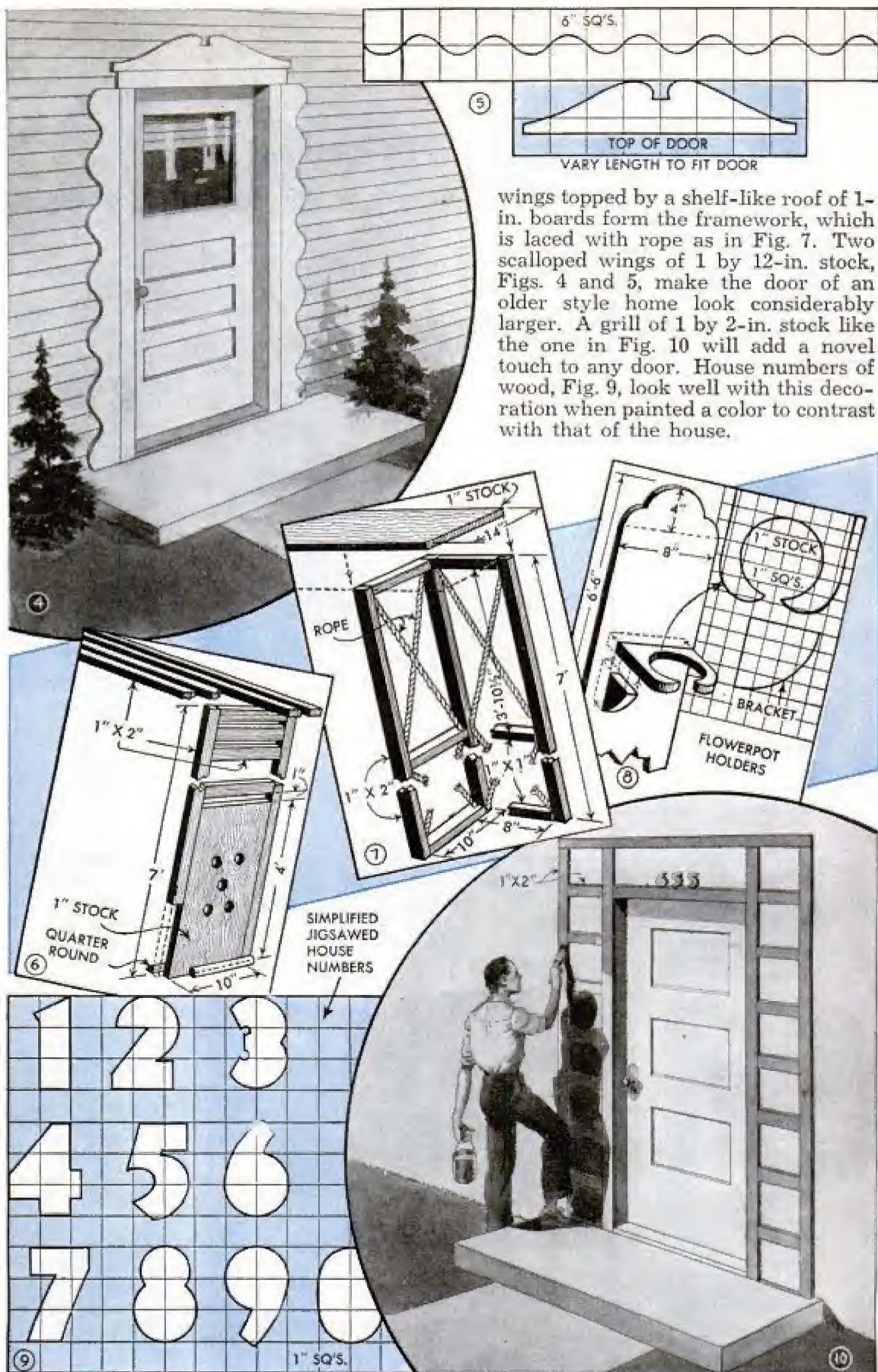
A 10-barreled mortar about to be fired on the Russian front

5 New Faces on Old Doors

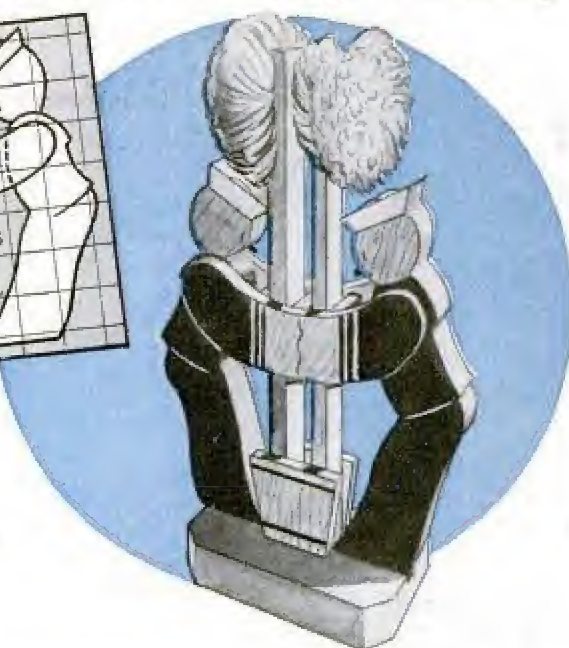
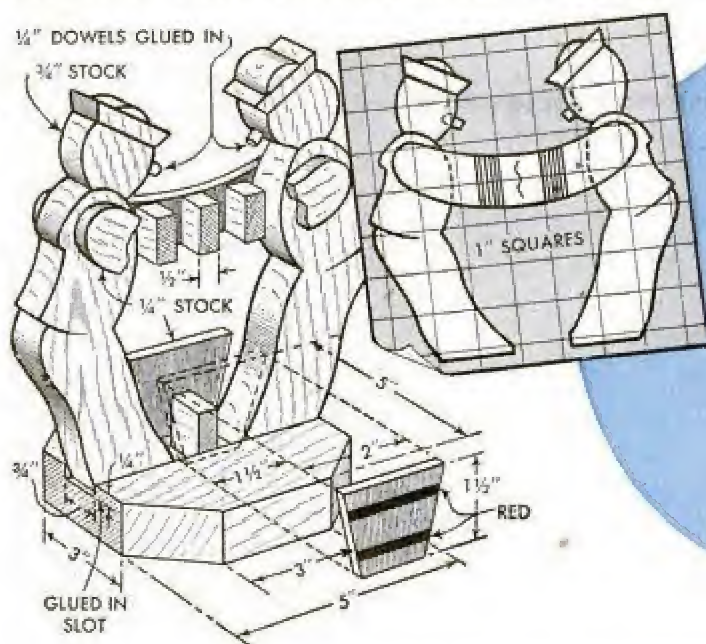
WITH little labor and expense, anyone can improve the appearance of a plain entrance door. For a modern stucco or frame house, imitation shutters form wings for the door and a trellis for vines as in Fig. 1. The sides, slats and top are made from 1 by 2-in. stock, and the bottom panels are 1 by 10-in. stock as in Fig.

6. Width and color are gained for the door of a frame house by topping it with a triangular strip of 1-in. stock and providing two wings of 8-in. boards as in Fig. 2. Three brackets to hold flowerpots on the wings are made as shown in Fig. 8. An appropriate doorway for the seaside home is shown in Fig. 3. Right-angle





Sailor Kitchen Rack Holds Dish Mops Handy



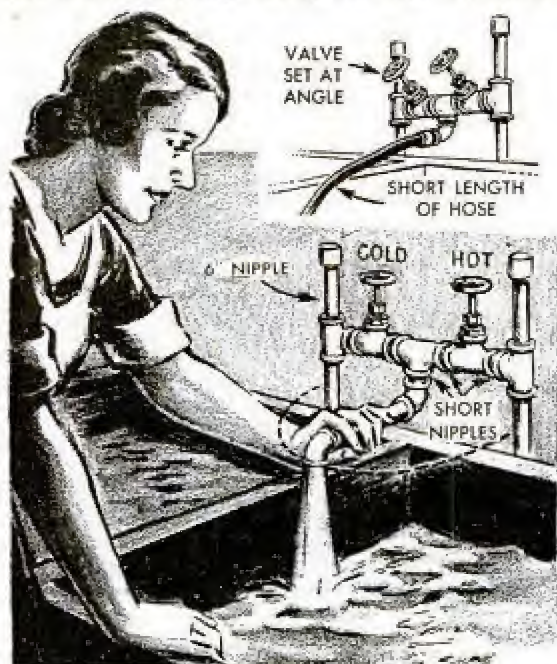
These gay sailors will keep your dish mops ready for instant use and hold them vertical so that they will dry quickly. The figures are traced on $\frac{3}{4}$ -in. stock and jig-sawed. A blind hole is drilled in each to take a short piece of $\frac{1}{4}$ -in. dowel for a nose. Arms are sawed from $\frac{1}{4}$ -in. plywood and are fastened with brads or small screws to the figures, which are glued into a

groove in the base. To hold the mops, four filler blocks each 1 in. long are cut from a $\frac{3}{4}$ by $\frac{1}{2}$ -in. strip and bradded in place, after which the bucket sides are attached and the color applied. The suits are blue with white sleeve stripes, caps are white, noses red, and the bucket striped as shown while other portions are merely varnished.

—R. L. Fairall, La Crescenta, Calif.

Swing-Spout Faucet for Laundry Made From Pipe Fittings

If you are unable to purchase a faucet for your laundry tubs, one can be made



from pipe fittings consisting of two valves, five close or short nipples, two 3 or 4-in. nipples and caps to form the air cushions, and two elbows and a 6 or 8-in. nipple to form the swing spout. If the vertical water pipes leading to the tubs are spaced too close together for this assembly, they can be spaced farther apart by offsetting one of them below the tubs with a couple of elbows and a short nipple. Although not shown, it will be necessary to use a union on one of the vertical water pipes for final assembly after the faucet has been installed. If vertical water pipes are too close to a wall for convenient operation of the valves, the valves can be set at an angle as shown in the upper detail. Also, instead of a spout, a length of hose can be used.

One housewife makes emergency elastic by cutting spirally around the end of an old inner tube until she has the desired length of narrow rubber strip, the ends of which are joined by pasting strong cloth over them and sewing through the cloth and rubber.

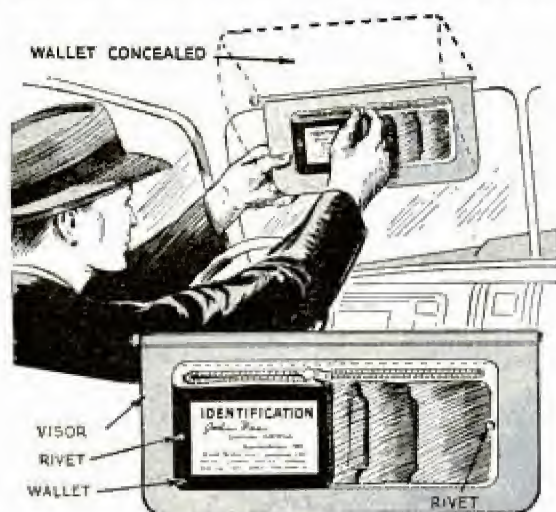
Boat Seams Are Calked Easily With Food-Chopping Knife



If you have had difficulty in finding a tool for pressing oakum into the seams of a boat when calking it, try a single-blade food chopping knife of the type shown. You will find the knife ideal for the purpose, and the rocking motion that can be imparted to the curved blade enables you to press oakum deeply and firmly into the joint.

Wallet Riveted to Auto Sun Visor Is Handy for Cards and Papers

You'll always have a safe place to carry gas and repair receipts, license papers, etc., that must be kept with the car if you rivet a wallet to one of the sun visors so that the wallet is out of sight when the visor is raised up. A wallet that has a currency pocket fitted with a slide fastener is best.



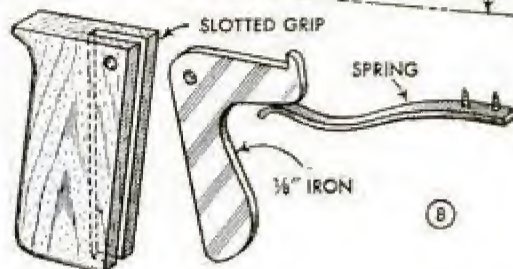
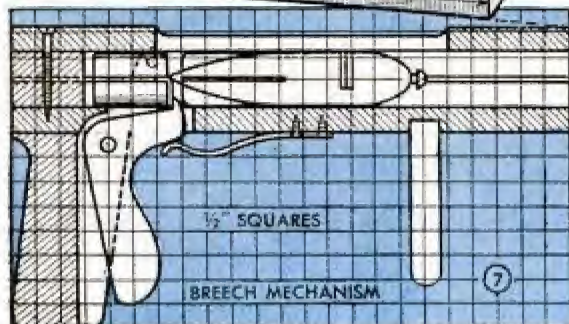
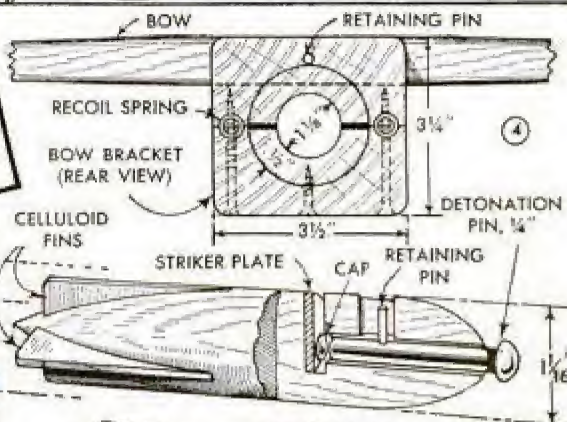
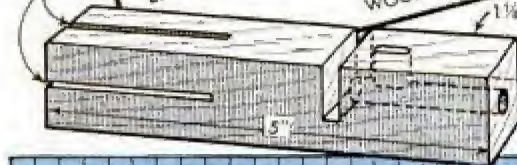
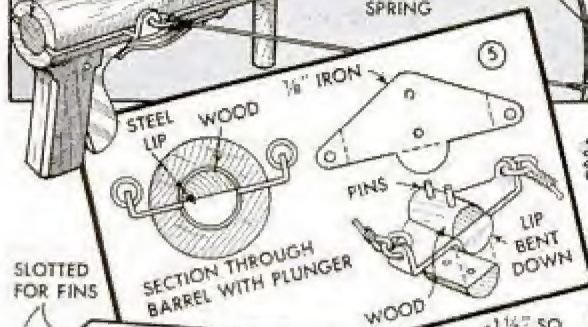
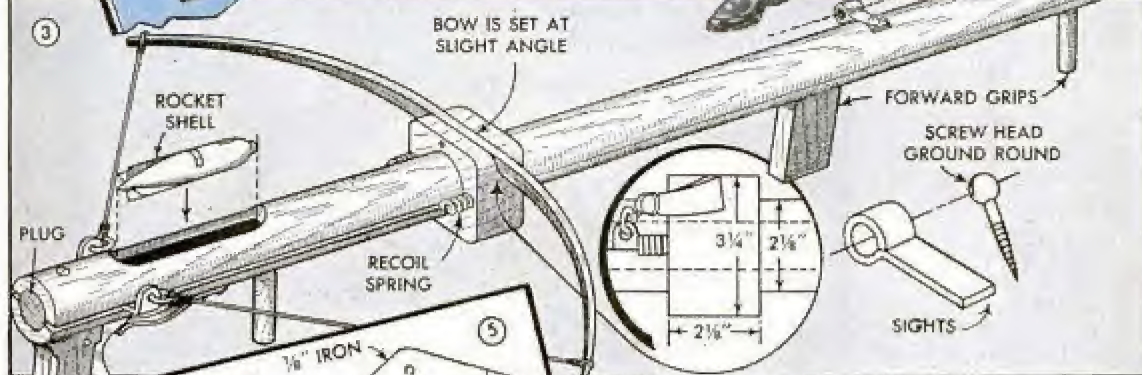
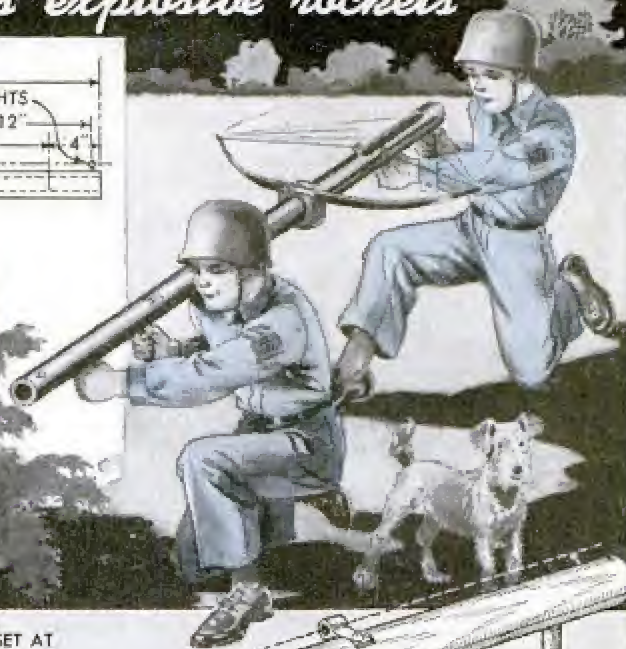
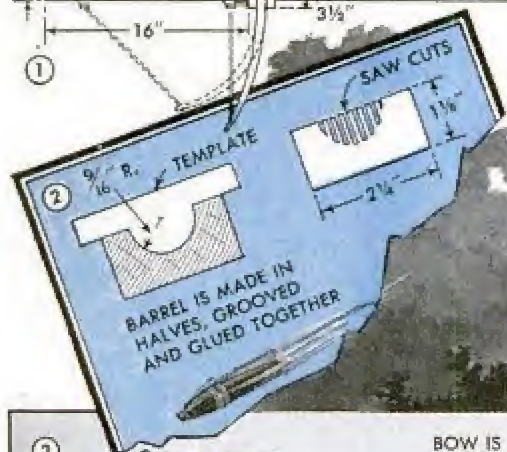
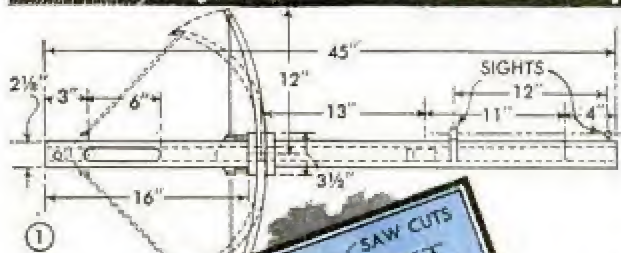
Fun With This Bow Bazooka

Patterned after the army's famous bazooka, this play gun will make it easy for backyard soldiers to neutralize enemy pillboxes. The gun fires a hardwood projectile that has a detonating pin in the nose to explode harmless caps when striking solid objectives. The propelling force is an ordinary hickory bow mounted on the barrel. General dimensions of the gun are given in Fig. 1. A larger bow may be used with a longer barrel. The barrel is made in two halves, preferably of white pine or redwood, which are light in weight and easily worked. Saw cuts are made as shown, the waste removed with a gouge and the groove trued up with a template as in Fig. 2. Then the halves are glued together and the outside turned in a lathe or trimmed down with a plane and drawshave. Assembly details are given in Fig. 3. Note that the barrel is slotted as far forward as the bow bracket for the plunger-yoke arms to slide in, and the end is closed with a breech plug. A loading slot is cut in the barrel to receive the rocket. Aiming sights consist of a flat-iron ring and a screw with the head ground off, the latter being screwed in or out of the barrel to obtain sight adjustment. The bow is set at a slight angle in the bracket that holds it on the gun as indicated in Fig. 3, the bracket being a wooden block bored to slip over the barrel and grooved to take the bow as indicated in Fig. 4. Note that the upper edge of the barrel also is grooved to take the lower edge of the bow, and that a retaining pin secures the bow in the bracket. Two small coil compression springs absorb the shock of the plunger yoke at the end of its stroke. Fig. 5 shows the plunger assembly, which consists of an iron plate with half-round blocks of wood to center it in the barrel, a lip being bent down at the rear edge to engage the trigger. This is made as in Fig. 8. It moves in a slot in the pistol grip and is held in the forward or cocked position by a flat spring. The rocket body is shaped from a block of hardwood as in Fig. 6. The detonating pin is a $\frac{1}{4}$ -in. bolt. Fig. 7 gives a general idea of the size and assembly of the breech mechanism. Before firing and when placed in the barrel, the bolt of the rocket should be pushed back gently against the cap so that the force of the bow will not fire it prematurely when the trigger is pulled.



BOW BAZOOKA

fires harmless "explosive" rockets



Solving HOME



PHONOGRAPH SPRING

An excellent rack for supporting jars of fruits or vegetables in a canning kettle is provided by an old phonograph spring with its coils opened up about $\frac{1}{2}$ in. apart

Below: If the cover of a paper ice-cream carton is hard to pull off, cut through the rim with a knife and it will come apart



ICE CREAM CARTON

Right: A miniature double boiler which is handy for melting chocolate or other foods can be improvised by placing a small measuring cup in one of larger size. Below: You can save time in rinsing rice by measuring the desired quantity into a large strainer and dipping this into a bowl of water

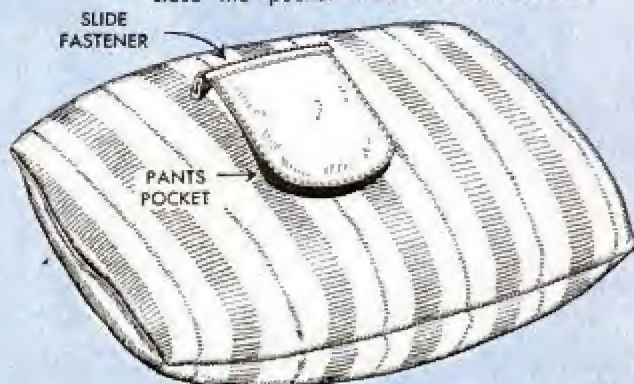


BENT PIN

Above: Basting pins are easier to use if they are bent as shown. Below: When it is necessary to keep valuables at hand during the night, they will be safe in a pocket stitched to the pillow as shown. You can close the pocket with a slide fastener



RICE

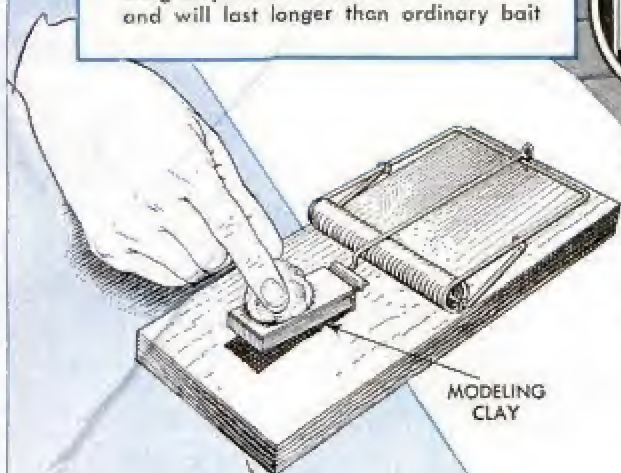


SLIDE FASTENER

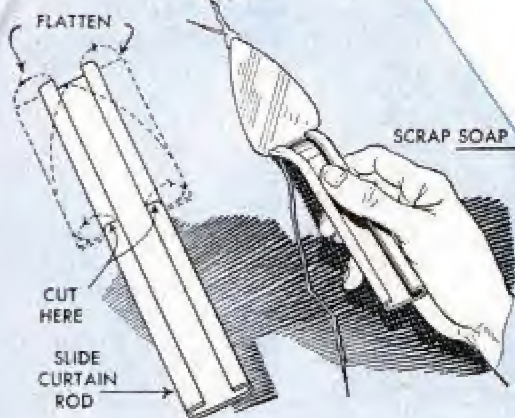
PANTS POCKET

PROBLEMS

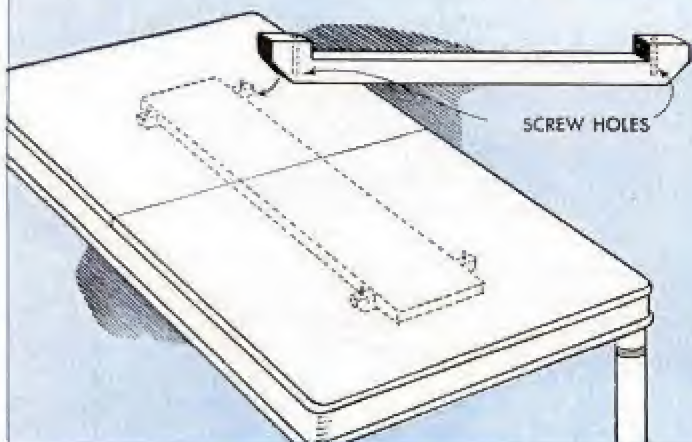
Below: Used in mousetraps as bait, modeling clay is effective, is not easily stolen and will last longer than ordinary bait



A child unable to reach a doorknob can open the door if one end of a fabric strap is fastened to the door shank as shown, so that pulling the strap will turn the knob



Above: A good trowel for small odd jobs about the house can be made by cutting and bending a piece of curtain rod as shown. Below: Storage space for extra table extension boards is provided by brackets screwed below the table



Left: Scraps of leftover soap will make good liquid soap if they are broken up and placed in a bottle filled with water. A shaker top dispenses this liquid soap quickly and easily. Below: Stains on silver are avoided and taking of medicine is much more sanitary if paper spoons are kept in the medicine cabinet for the purpose



Nonslip Surface Put on Sidewalk With Altered Push Broom

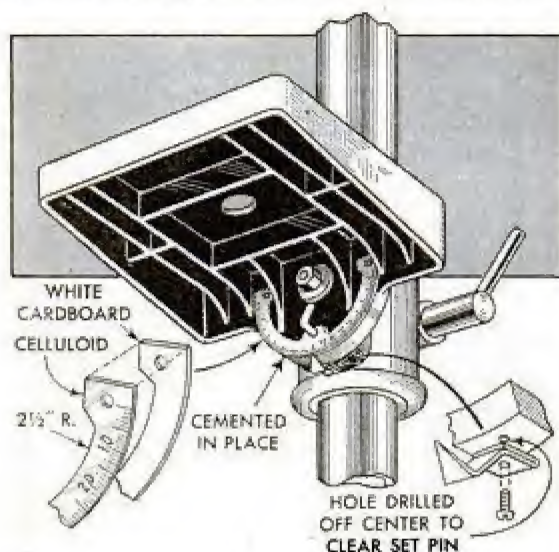


When a sidewalk is laid at a fairly steep angle it is advisable to roughen the surface to help prevent slipping when the walk is wet. To do this we use an old push broom from which alternate sets of bristles have been removed. By running the broom back and forth over the concrete before it sets, a number of shallow grooves are produced.

—Otto M. Kohler, Jr., Wheaton, Ill.

Precision Angle-Drilling Machine From Your Drill Press

Owners of small home workshop drill presses can use them as precision angle-drilling machines by fitting the tables with a scale as shown. Of course, the scale must be calibrated accurately for each machine. Celluloid or metal can be used for the scale. Celluloid is the easiest to work and if used, it should be cemented to the table, first cementing cardboard to the table and



then the celluloid to the cardboard. If riveted, the celluloid is likely to buckle between the rivets and be inaccurate. Metal can be riveted to the table. After scoring the calibrations in the surface of the scale, coat it with India ink and immediately wipe off, leaving the ink in the scores.

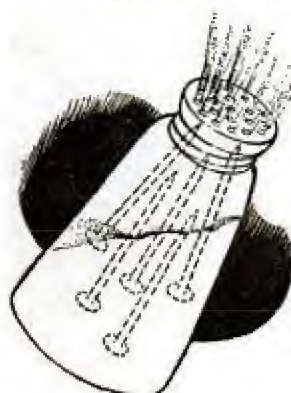
—Carl W. Bertsch, Philadelphia, Pa.

Corks Prevented From Sticking In Glue or Sirup Bottles

Sticking of corks in glue or sirup bottles or other sticky liquids may be prevented by any of these methods: Dip the cork in melted paraffin, and the wax coating will keep it from sticking. Cover the cork with waxed paper. Or replace the cork with a stopper cut from a candle and tapered to fit.

—Mrs. Hal Geihm, Aurora, Ill.

Nails Keep Abrasive Powder From Clogging in Shaker

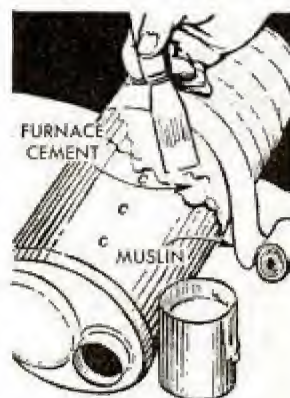


If you employ a saltshaker to apply abrasives or other powder to any surface, you can speed the action and prevent clogging by dropping several small nails into the shaker with the points toward the cap. These will strike the shaker holes from time to

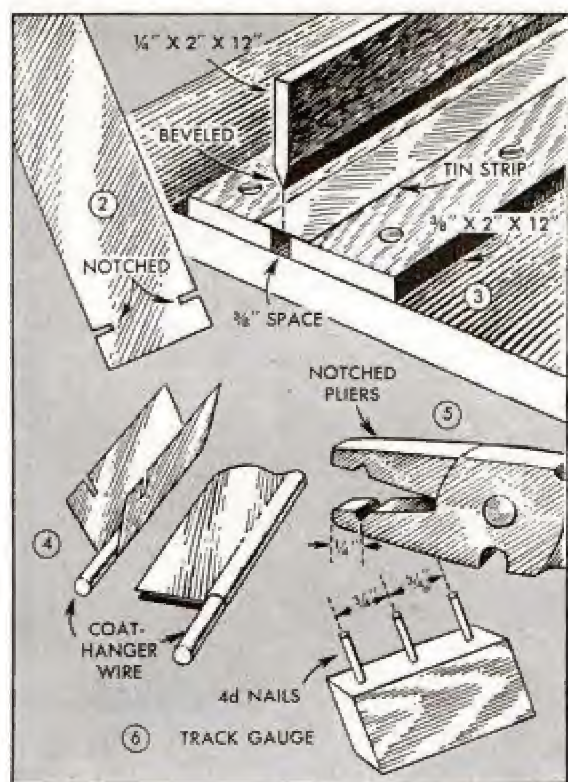
time and serve to keep them from clogging.

Simple Way to Repair a Muffler

Silencing motor operation and protecting motorists against deadly carbon monoxide gas does not necessarily mean installing a new muffler, although this is preferable where the parts are available. An easy and rather permanent repair can be made with ordinary furnace cement and strips of muslin. By coating the muffler thickly with the cement and binding it in place with the cloth similar to the way high-pressure steam pipes are wrapped, the life of the muffler can be extended almost indefinitely.



Model Train Track Is Formed From Tin Cans



You can make both straight and curved track for either "0" or "00" gauge toy trains from strips of metal cut from No. 2½ or larger tin cans. For straight track, 1 by 10-in. strips are needed, as in Fig. 1, but for curved track, the length should be ¾ in. longer for the outside and ¾ in. shorter for the inside rails. For sections of straight track, each strip should be notched ¼ in. from the ends, as in Fig. 2, to facilitate tacking them to ties. Curved rails must have an extra notch at the center. Each strip is creased by being placed over a ¾-in. space between two pieces of hardwood screwed to a baseboard, and pressed down by a narrow strip beveled at one edge, as in Fig. 3. Next, a 12-in. length of coat-hanger wire is placed in the crease, as in Fig. 4, and a pair of notched pliers used to force the metal tightly around the wire as in Fig. 5. Long-nosed pliers with the ends ground down and notches cut ¼ in. from the ends are best. While still gripping the track with the pliers, spread apart the double edge with a screw driver and tap down the sides with a small hammer to form the rail flanges, using the end of the pliers as an anvil, as shown in Fig. 7. The wire core can now be removed and the rails spaced by the track gauge detailed in Fig. 6, and fastened to the ties by No. 3 carpet tacks. Any scrap wood can be used for making the ties, which are ½ by ½ by

2 in. in size. Straight track sections have ties at the end only, and curved sections have a tie at the center also. Curved rails are bent to the desired arc before being attached to ties. After tacking down the rails, cut 1½-in. lengths of galvanized wire and insert these pieces into the ends of the rails to join track sections, and close the ends slightly with pliers to make a snug fit on the wire pins.

—B. S. Skinner, Decatur, Ga.

Curing Sticking Windows

Sticking of doors and windows often can be remedied by placing a two-by-four about two feet long edgewise against the jamb and pounding it a few times with a hammer. This moves the jamb enough to allow the door or window to swing freely.

—R. K. Fowler, Redding, Calif.

Keeping ELECTRICAL SERVANTS



THE average American home runs smoothly by virtue of a host of electrical servants. Although numerous, these servants readily classify themselves into three big families: (1) The Lighters, such as a floor lamp or any type of lamp bulb, (2) The Heaters, including toasters, irons, percolators, waffle irons, etc., (3) The Runners, covering all motorized devices such as refrigerators, washers, mixers and vacuum cleaners. It will be apparent that although mechanical construction may vary, certain ills of any one group affect all items in that group, thereby greatly simplifying the needed "know how" to make necessary repairs.

Cords and plugs: Cords and plugs are basic and apply to all electrical equipment. Most persons know how to make necessary repairs, but the few ideas pictured on this page may serve as a "refresher" course. Silk-cov-

• USE THREAD WRAPPING ON SILK-COVERED CORD TO PREVENT FRAYING

FIT LOOPS CLOCKWISE AROUND SCREWS



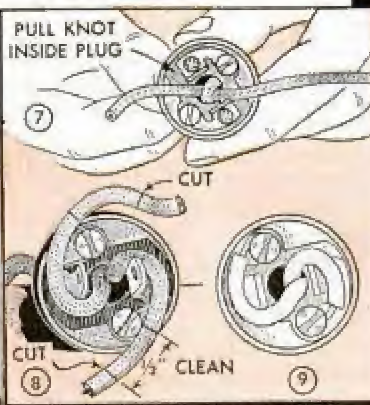
Cords

Common to all appliances, the cord should be checked first when anything goes wrong. Neat workmanship means good connections

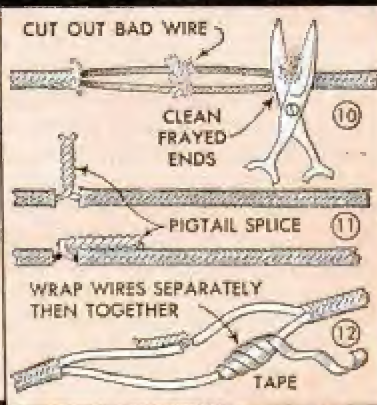
THREAD WRAPPING



UNDERWRITERS' KNOT PREVENTS PULL ON PLUG CONNECTIONS

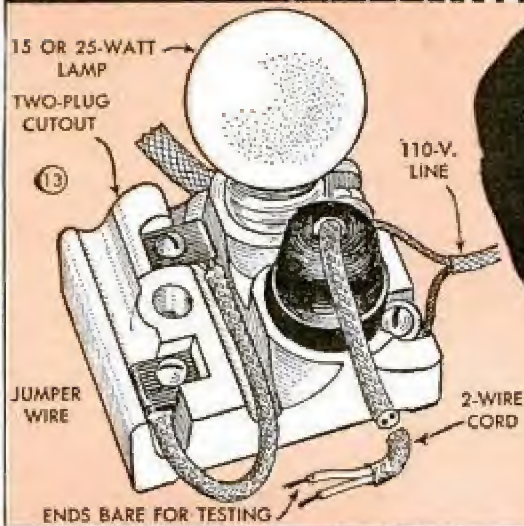


WRAP WIRES AROUND PRONGS TO DETERMINE WHERE TO CUT AND CLEAN



PROMPT ATTENTION TO FRAYED CORD WILL AVOID SHORT-CIRCUIT

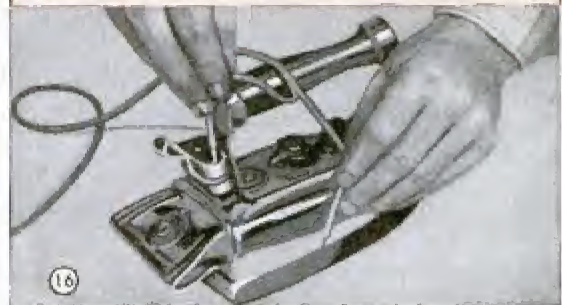
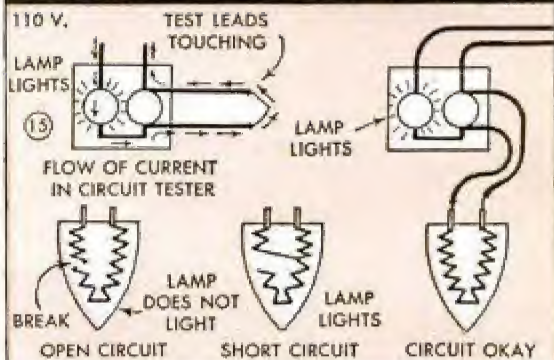
HAPPY



ered cords and asbestos-insulated cords should always be wrapped with thread when making plug connections to prevent fraying, as shown in Figs. 1, 2 and 3. The insulation should be intact right up to the point of contact, Fig. 4. The underwriter's knot for plugs as shown in Figs. 5 and 6 takes the strain of pulling on the cord and prevents strain on the connections. It is especially good with the popular parallel-wire rubber cord. Steps in making plug connections after tying the knot are shown in Figs. 7 and 8. The best practice is to leave the wire long and the insulation intact until actual fitting. Fig. 8 shows where to cut and clean. Fig. 9 shows a plug properly connected—the wire is pulled around the prongs and fitted clockwise under the screw heads. A frayed weak spot in a cord should be spliced promptly instead of waiting until the wire or fuse burns out due to a short circuit. The common splice joint is best made with pigtail splices, as shown in Figs. 10, 11 and 12. Each joint is wrapped separately with friction tape; then the two wires are wrapped together.

Circuit tester

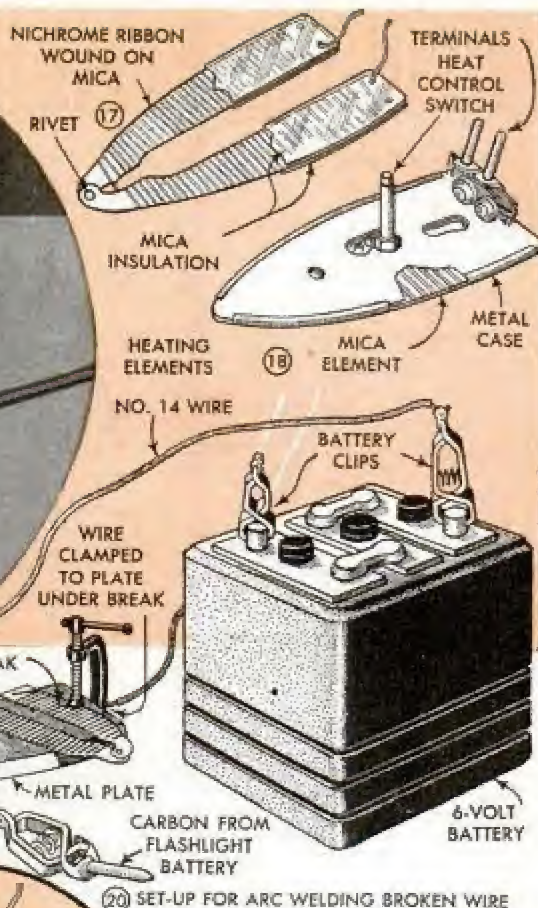
Best method of checking circuits in any appliance is to use the simple circuit tester shown—costs little and is useful on dozens of jobs





Irons

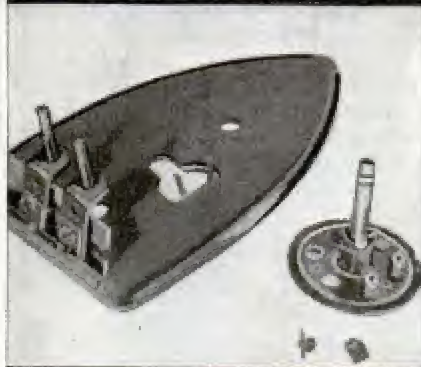
Usual fault is break in heating element, which can be repaired by splicing or arc-welding the severed ends



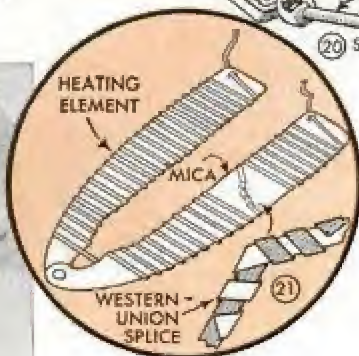
20 SET-UP FOR ARC WELDING BROKEN WIRE



22 LAMP SHOULD LIGHT WHEN TEST LEADS ARE TOUCHED TO SWITCH TERMINALS



23 DEFECTIVE SWITCH CAN BE DISCARDED. ELEMENT WILL WORK WHEN WIRES ARE SPICED



Circuit tester: While breaks in an electrical circuit usually can be traced visually, it is quicker and better to use a circuit tester. This is made up as shown in Fig. 13 and costs less than fifty cents. How it works is shown in Fig. 15—if you touch the two test leads together you make a complete

circuit, causing the lamp to light. Likewise if you apply the test leads to any circuit, such as a flatiron, as shown in Figs. 14 and 15, the lamp will light if the circuit in the iron is not broken. Also, it should be noted that the lamp will light if a short circuit exists, Fig. 15, but positively cannot light when the circuit is broken. The current passed by the bare wires of the circuit tester is limited to the size of the bulb used, and is not sufficient to actually heat the iron, run a motor, or do anything else which the straight 110-volt line would do. This doesn't mean that you shouldn't be careful—play safe and treat the two test leads as "hot."

Checking electric iron: Using the circuit tester, apply the leads to the prong terminals, as shown in Fig. 14. If the heating element is all right, the lamp will light. Apply one lead to the prong terminal and the other to the sole plate, Fig. 16. The lamp should not light. If it does the circuit is grounded, that is, some part of the wiring is bare of insulation and



The vacuum cleaner

Check cord first, especially at point where it enters handle. Universal type motor will give good service if kept oiled. Brushes should be inspected periodically and replaced when they become too short

touching the sole plate or cover. No light across the terminals shows that the circuit is broken. In this case, remove the handle, cover, and any other parts necessary to expose the heating element. The most common type of heating element is ribbon Nichrome wire wrapped on mica and insulated on either side with mica, as shown in Fig. 17. Better grade elements are covered with a metal case, Fig. 18, and it is necessary to pry off the case. Still other elements are built right into the sole plate in a solid mold; this type is not repairable except by obtaining a new replacement part.

Patching Nichrome wire: A break in the Nichrome ribbon or wire can be patched by twisting the two ends together, as shown in Fig. 21. A better method is to fuse the broken ends together with a small makeshift arc-welding outfit, as in Figs. 19 and 20. In use, the pointed carbon should be touched to the break delicately and only for an instant. You will get a flash of white hot wire and the two ends will fuse together. Prolonged contact generates too much heat and burns the wire completely. No flux is needed although borax can be used if desired. Sometimes the break is within a few turns of the post terminals, and in this case it is practical simply to unwind the broken section and make a new connection.

Electric-iron switch: If the iron has a heat-control switch, test it across the terminals, as shown in Fig. 22, to determine if the fault is in the heating element or the switch. If the switch is defective and a replacement not available, the iron can be made usable by twisting or welding the two ends together, as indicated in Fig. 23. There is little that can be done with a defective switch; make certain, however, that the thermostatic disk is not jammed open (saucer shape). Try mild pressure with your fingers in manipulating the disk—it should have a curved bell shape when the iron is cold.

Other heater-type appliances: Apply the same general tests as described. Always



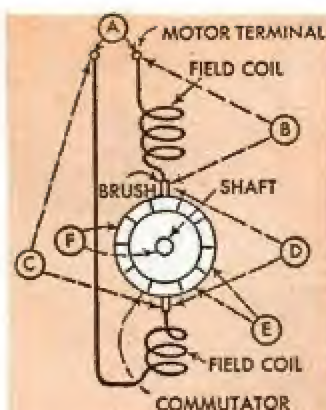
(24) CLEAN COMMUTATOR WITH FINE (8-0) SANDPAPER



(25) INSPECT BRUSHES AND FIT NEW ONES IF NEEDED

check the cord first (use test lamp and run current through both wires separately), and then proceed systematically until the fault is discovered. Some appliances, such as inexpensive toasters, can be checked visually since the heating element is in full view. Breaks in round Nichrome wire can be spliced much the same as described for ribbon wire. In all cases, press the splice flat and make it as tight as possible—any slight amount of arcing from a loose joint will immediately burn the wire.

Vacuum cleaners: With so many different makes and styles, about the only thing vacuum cleaners have in common is the motor. This is usually a series-wound universal type, a high-speed motor suitable for sweepers, mixers, fans and other light duty applications. If the motor goes bad, the first check point should be the brushes. These can be removed by unscrewing the caps which hold them in place, as shown in Fig. 25. Replace the brushes if they are worn too short. Test the spring tension to make sure that the springs keep the

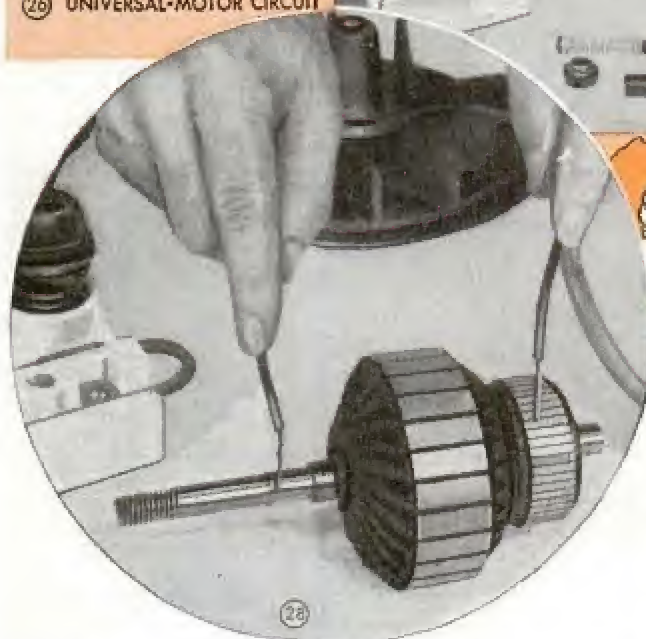


TEST LAMP SHOULD LIGHT AT ALL POINTS SHOWN EXCEPT (F)

(26) UNIVERSAL-MOTOR CIRCUIT



(27)



(28)



Universal motors

Wiring of this motor is quite simple and easily checked with a test lamp for broken circuits

brushes in contact with the commutator, (part against which the brushes bear). When replacing old brushes, be sure to fit them properly to the curve of the commutator. If new brushes are fitted, break them in by slipping a piece of fine sandpaper under a brush with the sand facing the end of the brush, then swing the rotor back and forth until the brush is ground to fit. Clean the commutator with gasoline, or sand it bright with fine (8/0) sandpaper, as shown in Fig. 24. If the commutator is grooved, the rotor should be removed to permit turning the commutator down smooth on the lathe. Other than motor failure, the most common causes of trouble are dirt and lint tightly wound around the motor shaft or the belt-driven brush, lack of oil, and poor bearings.

Universal motors: When checking a vacuum cleaner's universal motor with the test lamp, remove the motor from the

cleaner. Fig. 26 shows the simple circuit of a universal motor. In testing across the lettered points, a light shows that the circuit is continuous. Fig. 27 illustrates test B. A light shows that this field coil is continuous, but although the wiring is intact, the insulation may be burned off. Test D checks the coils of the rotor or armature. If no light is obtained, test each adjacent pair of commutator segments all around, as at E. Each pair should light; no light indicates that the coil is burned out between these two segments. This condition will cause considerable sparking at the commutator, also the motor will be dead if it stops with the dead coil in contact with the brush. A repair job can be done by "jumping" the segments together by soldering a copper wire across the ends. If the test lamp lights when making test F also shown in Fig. 28, insulation has been scraped or burned from armature coil or coils, and the wire is touching the shaft causing a "ground."

When the test lamp does not light when it should, careful inspection should be made of the circuit being tested. Unless the motor is burned out, breaks usually will be found at the ends of the wires and can be repaired. When it is definitely determined that the motor is burned out, it should be junked or turned over to a service shop for rewinding.

D-I-Y-5
+ D-I-Y 13

Home Repairs

Proper care will make them last longer



Electric iron

Polish bottom with very fine steel wool. Rub frequently with waxed paper. Always plug in at outlet; keep the iron plug in place. If arcing occurs at plug, take plug apart and squeeze contacts lightly with pliers. Keep cord in good condition



Toaster

Have a long bristle brush handy for wiping out crumbs. Never immerse toaster in water—clean only with damp cloth. Breaks in heating element can be repaired the same as described for irons (see text). Never use a fork to remove toast



Refrigerator

Replace door seal if it does not hold sheet of paper with door closed. Keep condenser clean by brushing or vacuum cleaner attachment—dirt and dust make motor run overtime. Allow room at back and over top so that refrigerator can breathe



Coffee maker

Never dip electric parts in water. Percolator has fuse in bottom to prevent overheating if it boils dry—remove with screwdriver and replace if needed. Glass vacuum coffee maker should be cleaned once a week with baking soda in water just as if you were making coffee



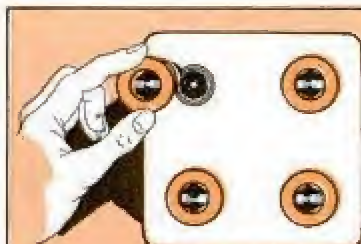
Motors

Oil regularly and keep clean so that motor can breathe. See that pulleys are properly aligned and tight on shaft. Be very careful not to stall split phase motors. If motor is universal type, check brushes regularly and clean commutator. Use proper size fuse to protect motor



Washing machine

Don't overload. Always clean after using and release pressure on wringer rolls. If stored in cold place, give it time to warm up in warm location to soften grease in gear case. Be sure that all moving parts are well lubricated. Check periodically for loose bolts and screws



Fuses

Under average conditions, circuits with lights should not have fuses larger than 15 amperes. Convenience outlets take 20 ampere fuses. Large fuses are no protection—the house wiring itself will burn up before the fuse blows. When installing new fuses, play safe—pull the switch



Cords and plugs

If plug does not make contact at outlet, bend prongs slightly outward. Avoid overloading outlets—the maximum load on any one circuit should not exceed 1400 watts. Keep all cords free of kinks. Hang cords on round peg when not in use—don't throw them in a drawer



Lamps

Keep lamp bulbs clean for maximum illumination. Use one large bulb instead of several small ones—a 100-watt lamp gives 50% more light than four 25-watt lamps. Do not use fuses larger than 15 amperes when there are lamps on the circuit. Use proper type of shade

Block Extension Aligns T-Square At Bottom of Drawing Board



Use of a T-square very near the bottom of the drawing board is facilitated by this triangular extension, which is fitted onto the bottom of the board and held in place with dowel pins. The square then may be held firmly against the extension where otherwise it would have no support. The extension can be removed easily whenever desired.

Sectional Pipe Roller Turns Boxes And Heavy Crates Easily

The difficulty of turning a heavy crate that is being moved on an ordinary pipe roller may be overcome by cutting the pipe in short sections and slipping these over an axle of smaller pipe, using pipe caps at

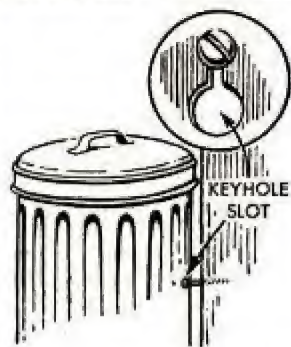


the ends to hold them in place. Thus in the turning, the sections may rotate independently and thereby give a differential action to the roller.

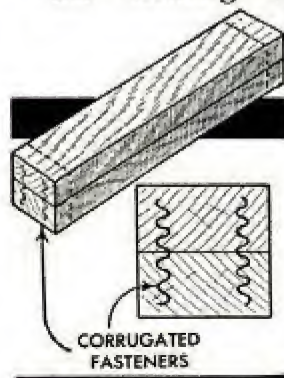
Garbage Can "Screwed" to Wall

To prevent a garbage can from being tipped over by small animals, attach it to a wall or post by means of a round-head screw as indicated. Drill a hole in the side of the can to take the screw head, then file out a section above the hole to form a keyhole opening. This will permit easy release of the can when it is to be emptied.

—Ken Murray, Baltimore, Md.



Corrugated Fasteners Save Time In "Gluing" Split Turnings

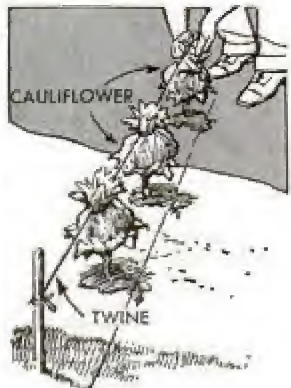


There's no waiting for glue to dry when you use corrugated fasteners instead of glue paper to hold split turnings together. Here the stock is cut extra long to provide sufficient waste at the ends so that the fasteners will not interfere with the

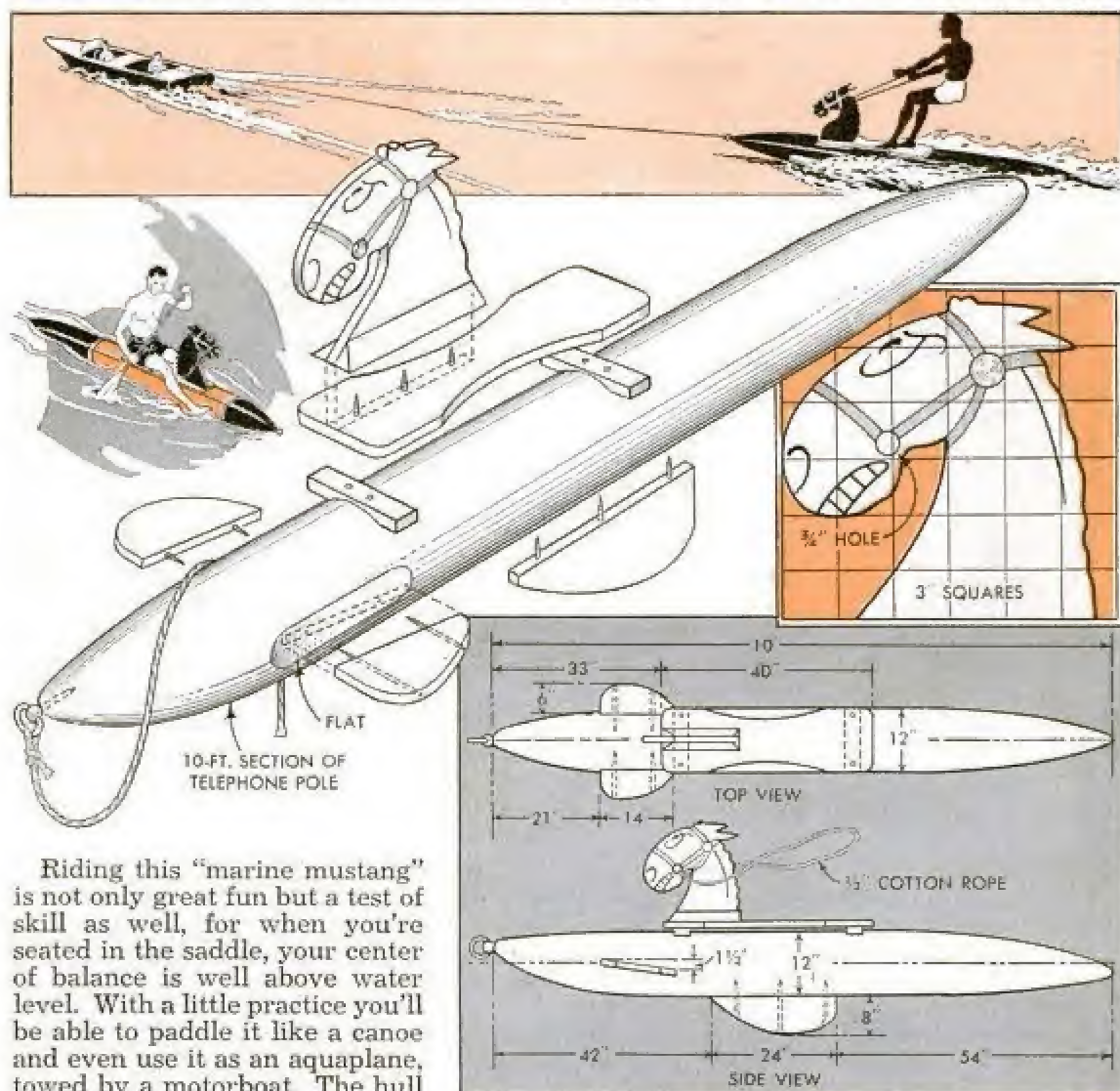
turning. Two fasteners driven flush in each end of the work will hold it firmly together.

Easy Way to Blanch Cauliflower

Here's an old gardener's tip to blanch cauliflower heads so they will be tender and evenly colored. To do this, run a length of twine between two stakes so that it may be looped once around the gathered outer leaves of each plant, thus enclosing the heads and sheltering them from the rays of the sun. This should be done when the heads are about 1½ to 2 in. in diameter.



Put to Sea on a Galloping "Marine Mustang"



Riding this "marine mustang" is not only great fun but a test of skill as well, for when you're seated in the saddle, your center of balance is well above water level. With a little practice you'll be able to paddle it like a canoe and even use it as an aquaplane, towed by a motorboat. The hull or float is a 10-ft. section of discarded telephone pole. With adz, draw-shave and plane the ends are streamlined as indicated and a towing ring is installed in the tip. Two cleats are mortised into the top for deck supports, and a pair of planing fins of $\frac{3}{4}$ -in. stock attached at an angle on

the sides by long lag screws. The keel is secured in the same manner. The head is scrollsawed from pieces of $\frac{3}{4}$ -in. material held together by long dowels or $\frac{1}{4}$ -in. bolts running across the grain to prevent splitting, and braced with triangular cleats.

Honing on Leather Gives Woodworking Tools Keen Edges

An excellent leather hone to get keen edges on woodworking tools can be made from scraps of dry oak-tanned sole leather, obtained from a shoe-repair shop. Cut the pieces roughly to $\frac{5}{8}$ by $2\frac{1}{2}$ in. and assemble enough of them to make up a block 5 to 8 in. long. After the smooth (hair) side has been trimmed or sanded, all surfaces are coated with a good grade of hot hide glue and clamped together under moderate pressure. When the glue has dried, smooth both sides of the block on garnet cloth,

scrape the surfaces slightly to remove clinging grit grains and apply several coats of saddle soap to both sides; soak for an hour in neat's-foot oil. One side of the hone should be treated with a cream-thick mixture of finest silicon carbide or aluminum oxide, flour and lard oil, well rubbed in. Leave the other side plain or rub it with jewelers' rouge. Use the hone exactly as you would an oilstone except that you stop the tool from its edge instead of against it.



By Gray Wolf

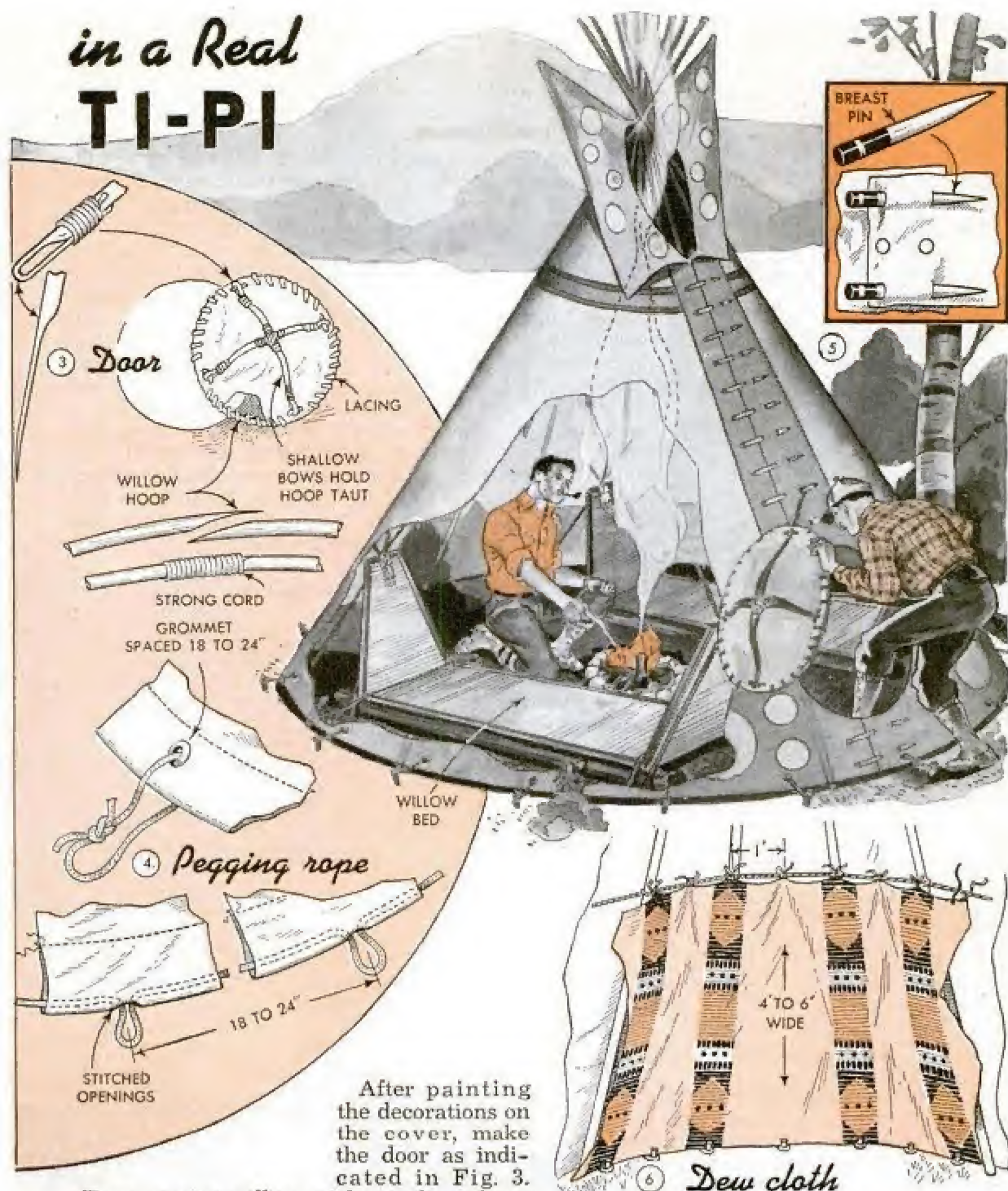
WITH this ti-pi, (Indian word from which is derived the English "tepee") you can satisfy your yen for the primitive and still be dry and warm. In addition, a ti-pi is easier than a tent to transport, the covering and some small rope being about all that is necessary, as the rest of the equipment needed is available at your campsite. Size of the ti-pi depends on your requirements. For two people, the 10-ft. Blackfoot design shown is ample. Fig. 1 explains the various symbols in the design.

In making a ti-pi, first cut out the cover according to the pattern in Fig. 2. If possible, the cover should be cut from one piece of canvas without seams. Notice that the shape is not quite a complete half circle, the center point being located between the smoke flaps. Be sure to cut 6 in. outside of the inner line to allow for a bottom hem. This is sewed all around and grommets inserted at 18 to 24 in. intervals to take pegging ropes as in Fig. 4. Or, a rope can be sewed in the hem and loops brought out as shown, in which case the openings for the loops must be stitched to prevent tearing. Next, corresponding holes for breast pins are made and reinforced along the straight edges of the cover between the smoke flaps and the door opening, and also below the door, Figs. 2 and 5. In

cutting the door opening, allow for a seam or hem as this will make a rigid entrance.

At the top of the ti-pi another reinforcement of double canvas is made as indicated by the shaded portions in Fig. 2, and a rope sewn in between the two pieces for tying the cover to the lifting pole. Ropes tied through grommets in the lower points of the smoke flaps should reach to the ground, as they serve to tie the smoke flaps snugly in rainy weather. This completes the cover except for its decorations. Of course, these are not necessary, but for sake of realism they are well worthwhile. Many pictures are available on authentic ti-pi designs.

in a Real TI-PI



After painting the decorations on the cover, make the door as indicated in Fig. 3.

From strong willow sticks, make a hoop about 6 in. larger than the opening, beveling the two ends to overlap, after which you lash them together with strong cord as shown. The cross bars for the door should be long enough to form shallow bows. Lace the door covering to the hoop, and at each quarter of the circle pass the cord through the looped end of a cross bar, allowing one end to extend to permit hanging the door to a breast pin. Tie the cross bars together at the center.

For added comfort, a lodge lining or dew

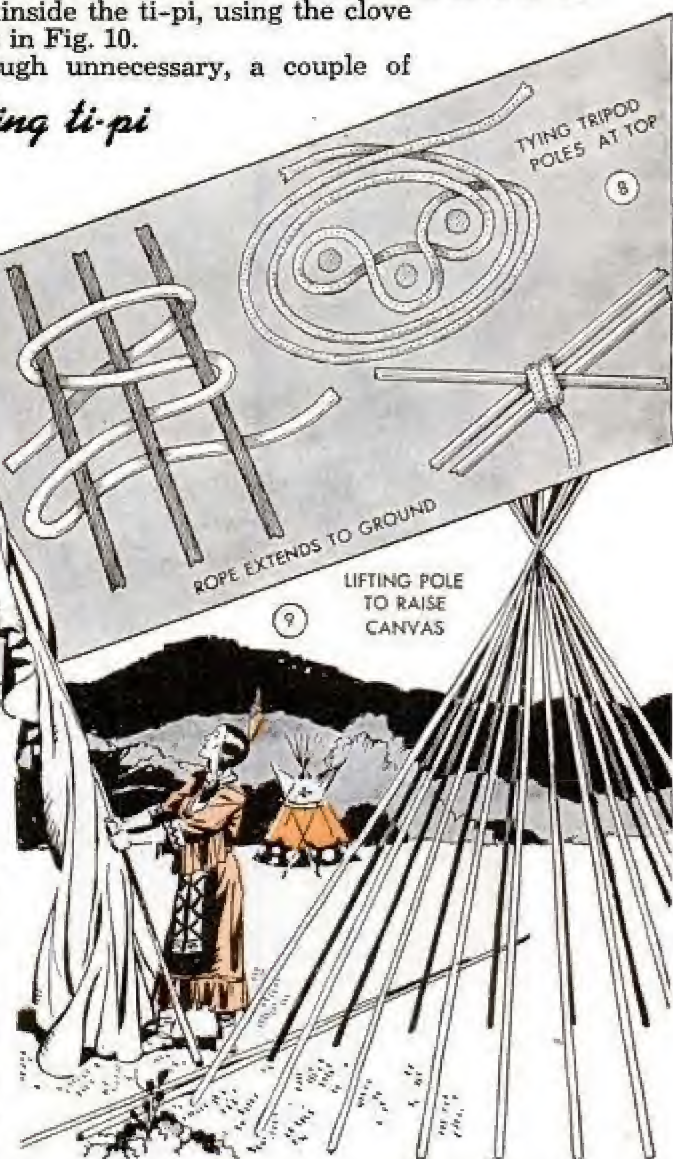
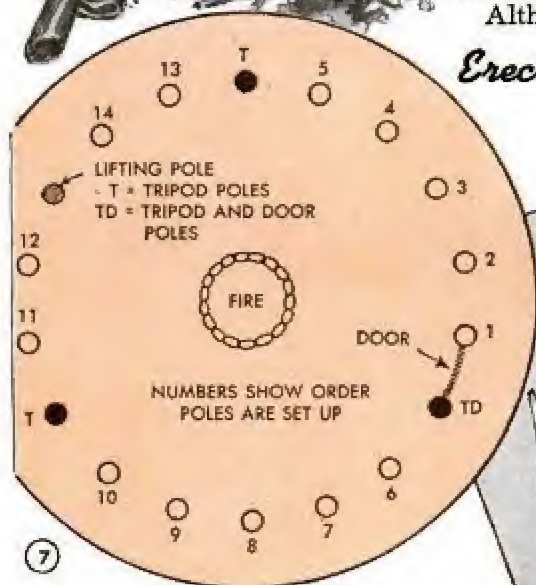
cloth as Indians call it, should be used. Make this from light canvas in several sections as in Fig. 6. Tie the top edge to a rope which is looped around each pole and peg the bottom edge to the ground. The sections should overlap. The lining serves several purposes: Extending from the pole on one side of the door around the ti-pi to the pole on the other side, it serves as a flue, causing the air that enters under the side of the ti-pi to rise between the canvas side and the lining, thus providing a draft



a tripod with equal distances between the poles. Fig. 7 shows the order in which other poles are set up, their upper ends resting in the crotch of the tripod. The last pole should be stout as it is the lifting pole. This is placed under the ti-pi cover and the tie strings at the top, Fig. 2, are fastened to it. Then the canvas is folded back, the whole thing is set in place, after which the canvas is brought around the framework, lapped over and closed with the breast pins. From inside the ti-pi, you gradually move the poles outward, one at a time, until the canvas is tight and smooth. Then peg the bottom to the ground. Put up the lodge lining, build a round stone fireplace and set the smoke flaps. To do this, insert slender poles into pockets sewed to each flap and then raise the flaps, crossing the poles as shown in Fig. 1. If the wind blows the smoke back into the ti-pi, move the flaps around in one direction or another until the draft is right. In case of rain, move one pole clear around to the front and move the other to close the opening. However, there still will be a small opening left for smoke to escape. In severe windy weather, tie the long rope extending from the top of the tripod poles to two pegs driven into the ground inside the ti-pi, using the clove hitch as in Fig. 10.

Although unnecessary, a couple of

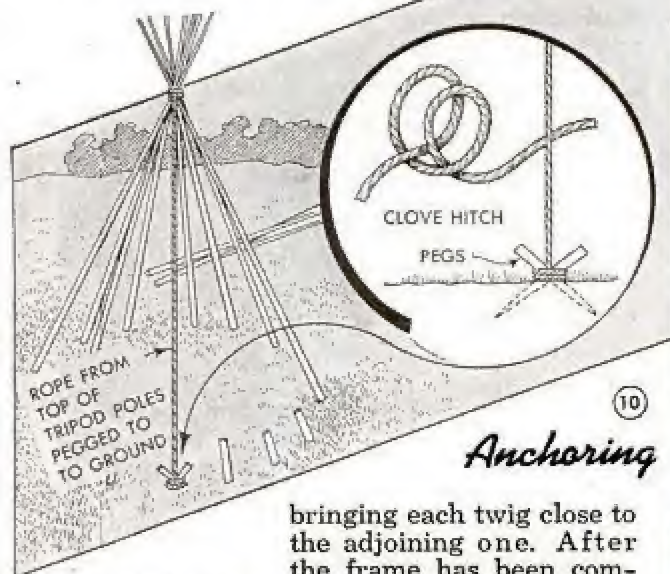
Erecting ti-pi



to carry the smoke up through the smoke flaps. Also, when you are seated inside the ti-pi the updraft is above your head. In case of rain, the lining prevents water that may run down the poles from dripping on you.

To set up the ti-pi, use sixteen slender poles 3 to 3½ in. thick at the base and about 3 ft. longer than the height of the ti-pi. Select three of the best ones, spread out the cover and lay two poles along the center and one on the edge. Tie them securely together where they cross, using the method shown in Fig. 8. Allow the rope to extend far enough to reach the ground when the ti-pi is raised. Now, lift the poles, Fig. 9, and spread them to make

willow beds made as shown in Figs. 11 to 16 inclusive will make sleeping more comfortable. Arrangement of beds and fire-place inside the ti-pi is shown in Fig. 5. To construct a bed, first make a framework to the dimensions given in Fig. 13 by driving pegs into the ground and tying strong cords between and across them. Next, cut and peel a number of willow twigs, making the longest ones 32 in. for the horizontal portion of the bed, slowly graduating the twigs in length to form the backrests. Drill or burn holes through the twigs 1 in. from each end. Next, place the twigs on the frame and lash them to the outer cords as in Fig. 14,

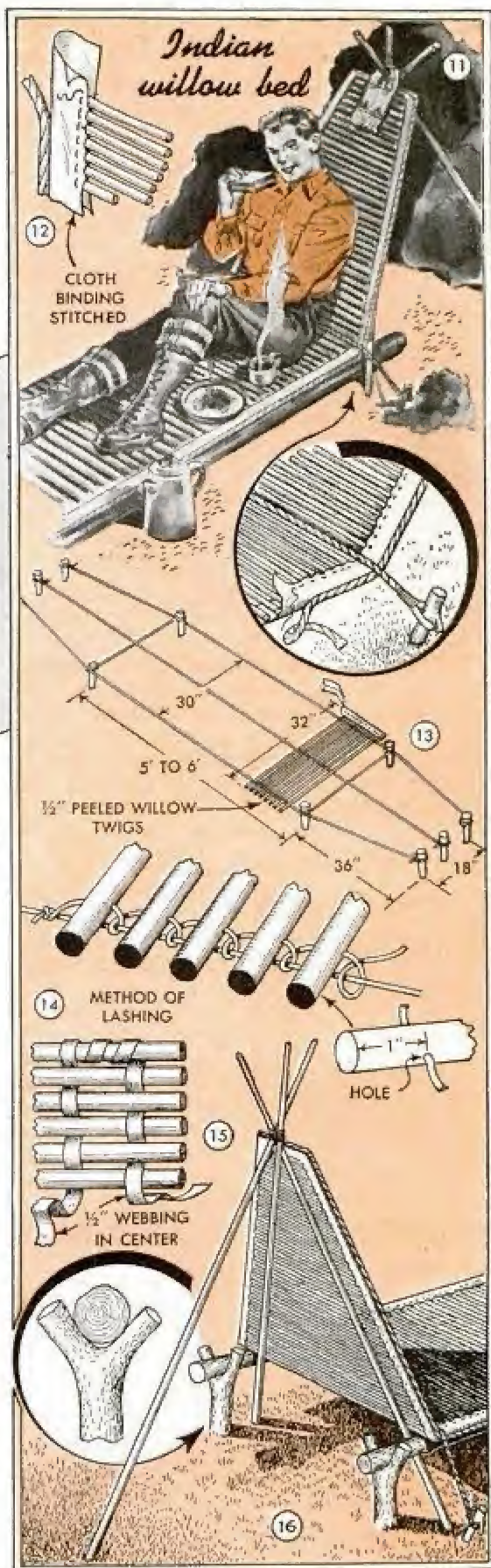


Anchoring

bringing each twig close to the adjoining one. After the frame has been completed, it is a good idea to bind the edges with strips of colored cloth by folding it over the ends as in Fig. 12 and stitching between the twigs. If greater stability is desired, weave $\frac{1}{2}$ -in. webbing through the center of the bed as indicated in Fig. 15.

To set up the bed, select two logs and peg them to the ground as in Fig. 11. Place the bed on them and hold the backrests in place by two tripods. To hold the bed firmly, a cord should pass over the bed and be tied to a peg on each side as in the circular detail of Fig. 11. In damp weather set the bed on logs and forks as in Fig. 16. Select strong logs or poles that will support your weight without sagging in the center and lay them in the crotch ends of strong stakes driven into the ground to project at a uniform height.

A sleeping bag on one of these beds will enable you to sleep comfortably. However, if you have no sleeping bag, a long sack made of white duck and filled with beech leaves will provide a good mattress. When not in use as a mattress, the sack provides a good container for your bed.

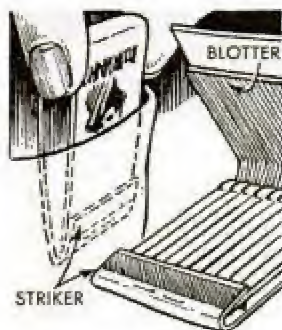


Anchoring Large Beach Umbrella Firmly Against the Wind



To keep a beach umbrella from rolling away in the wind, anchor it with a few can lids tied to the ribs and buried in the sand. The lids are punched through the centers to receive stout cords which are knotted to keep them from pulling through the punctured holes.

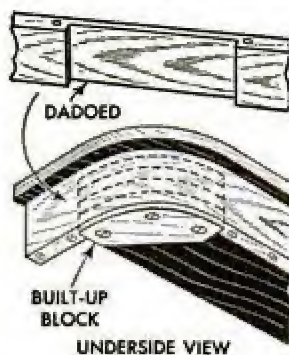
Blotter Keeps Matches Dry



Workers or sportsmen who carry book matches in pockets where they may be ruined by perspiration will find a piece of blotting paper helpful. Placed around the matches it will keep them dry.

Neat Way to Curve Thick Stock

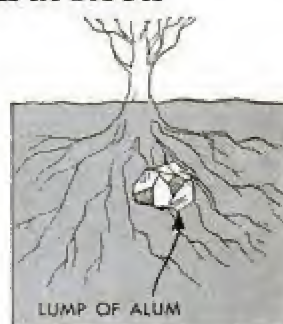
Easier than kerfing, here's a way you can bend thick stock in a continuous strip around corners, such as when adding set-in bases to cabinets, chests, etc. First, the corner is fitted with a built-up block as shown. Then the



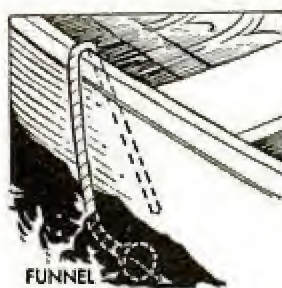
strip to be curved is cut down in thickness at the point where it is to be bent, or a distance equal to the perimeter of the block. The radius determines the amount the work must be cut down, the smaller the radius, the thinner the thickness. Cut in this way, and with one end of the strip screwed to the cabinet, the strip can be curved around nicely without splitting.

Blue Hydrangeas Are Produced By Alum at Roots

Blue hydrangeas are produced by a Wisconsin flower grower by inserting a lump of alum among the roots of the ordinary white type. The color to which the blossoms turn after this treatment is a novelty.



Seepage Water Drawn From Boat Through Suction Tube

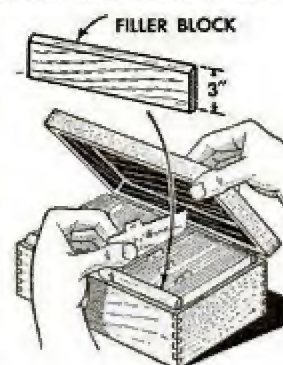


A flexible or bent metal tube with a funnel slipped in the end can be used to draw seepage water from the bottom of a boat automatically. When the boat is in motion with one end

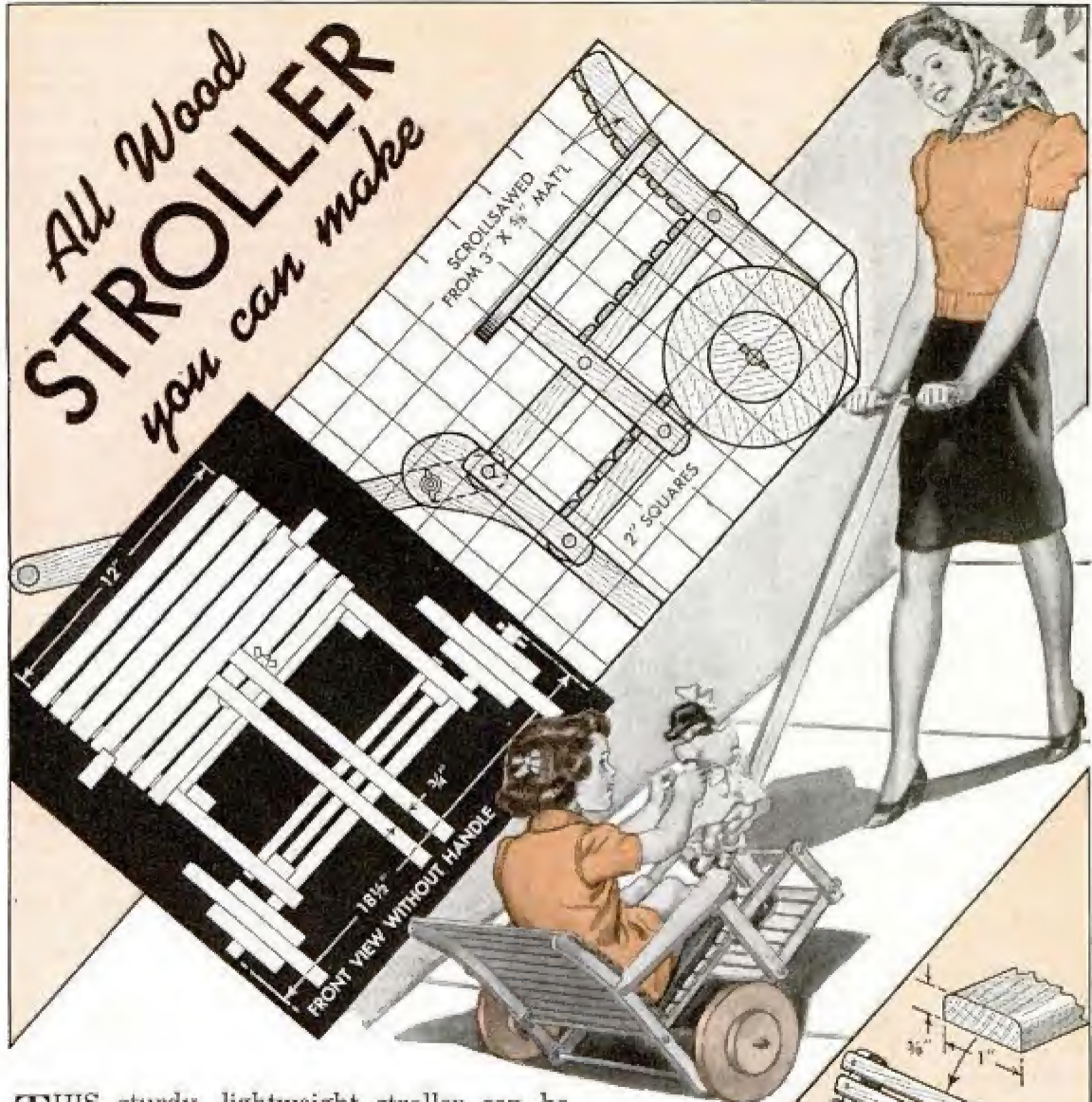
of the tube touching the floorboards and the funnel end dragging through the water, suction pulls the water out.

Blocks Adapt Box as Card File

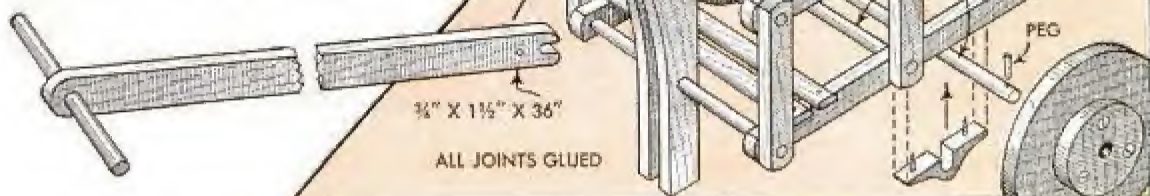
Wooden cigar boxes and similar boxes can be converted into durable and attractive 3 by 5-in. card index files. Wood blocks rounded at the top are inserted along the sides of the box to reduce the inside width of the box to 5 in., the length of the cards. Imprinted lettering on the box, if objectionable, may be removed with rough sandpaper. The card file will hold several times the number of cards contained in small file boxes.



All Wood STROLLER you can make



THIS sturdy, lightweight stroller can be used on shopping trips as well as in the home as a chair for the baby. Space under the seat is floored for carrying packages, and the notched handle is retained by a removable wing nut. The axle is a $\frac{3}{4}$ -in. dowel lubricated with graphite, and the frame is joined from side to side by $\frac{5}{8}$ -in. dowels. The grain in the wheels and hubs should run at right angles for maximum strength. Glue and screws at all dowel joints will add rigidity to the vehicle. Oak stain and spar varnish will protect the stroller from the weather as well as add to its finished appearance.



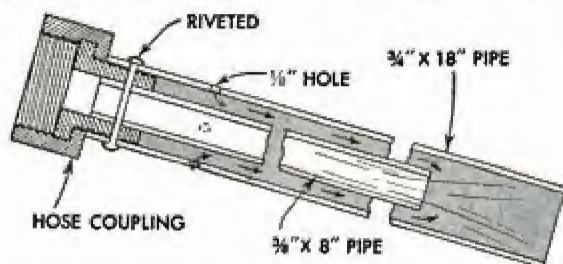
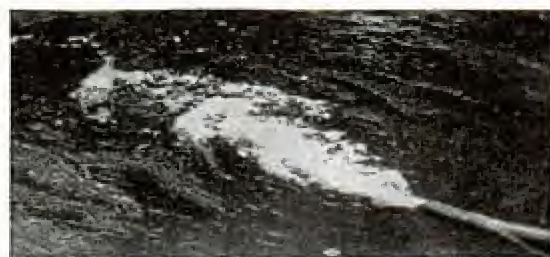
Pocket End Stitched in Auto Robe Holds It on Back of Seat



To keep an auto robe from dropping down or sliding from side to side when used as a seat cover, fold one end over and stitch it at the sides to make a pocket about 6 or 8 in. deep. The robe then may be placed over the seat so that the pocket fits over the back to hold it securely in place.

Special Nozzle Aerates Water In Your Fish Pool

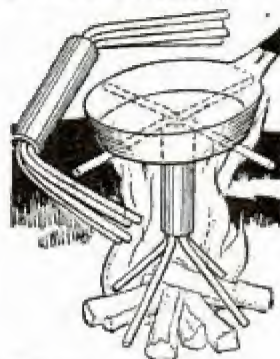
With this nozzle you can aerate your fishpool at the time fresh water is added, thus making it unnecessary to completely change the water at frequent intervals. The nozzle consists of an 18-in. length of $\frac{3}{4}$ -in. pipe, an 8-in. length of $\frac{3}{8}$ -in. pipe and a hose coupling. To assemble the nozzle, insert the small pipe inside the coupling, slip the large pipe over it and rivet the assembly together as indicated. Then,



1 in. from the coupling end of the larger pipe, drill four $\frac{1}{8}$ -in. holes, spacing them equally in a row around it. In use, connect the nozzle to your hose, insert the end into the pool water almost to the small holes and turn on the pressure. Water rushing through the nozzle will pull air in through the small holes and mix it with the water in the pool.—J. Hobert, Hempstead, N. Y.

Simple Homemade Camp Stove Bundles Into Small Package

A portable camp stove can be made by inserting four iron rods through a short length of pipe and then bending them as indicated. The rods may be spread apart to support a utensil over a fire, or folded for carrying.



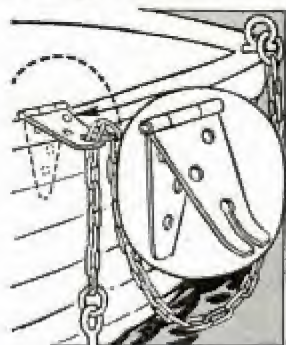
Birds Are Unable to Damage Corn When Ears Are Tied at the Top



You can protect your sweet corn from birds that peck the ears at the ends by tying the tops of the husks with thread or cord when the kernels start to develop. The birds, unable to tear the ear open from the side, cannot reach the kernels.

Holder Supports Anchor of Boat To Change Fishing Location

Instead of pulling the anchor into the boat every time he wanted to move a short distance to a new location, one fisherman uses this simple holder to support the anchor a few inches off the lake bottom. The holder is merely a hinge screwed to the inside surface of the boat so that one half of it hangs over the side, the end of the hinge being slotted to take the anchor chain.



Servicing Your OUTBOARD

HAVE you ever noticed some fisherman fruitlessly cranking his outboard motor with an occasional "spit and sputter" the only reward for his labor? Such hard starting generally can be avoided if you use the recommended gas-and-oil mixture and if the motor is properly serviced from time to time to keep it in tip-top condition.

Ignition: Housed under the flywheel, Fig. 13, the ignition system of a modern outboard motor is surprisingly dependable, but it does require attention. At least once each season the flywheel should be removed and the entire magneto cleaned and adjusted. On many motors the nut that tightens the flywheel also serves as a flywheel puller, Fig. 1. A shoulder on the nut contacts the starting-ropes plate, and after the nut is loosened, a turn or two forces the flywheel from the tapered end of the crankshaft. All electrical connections should be checked for tightness. A loose condenser should be tightened, Fig. 2, as this may cause hard starting. Ignition points should be faced true on an oil stone and set to factory specifications. In the absence of such information, adjust the points to open .018 to .020 in., Fig. 3. Lubrication consists of a tiny bit of light oil applied with a toothpick to the pin that supports the movable contact point, and just a touch



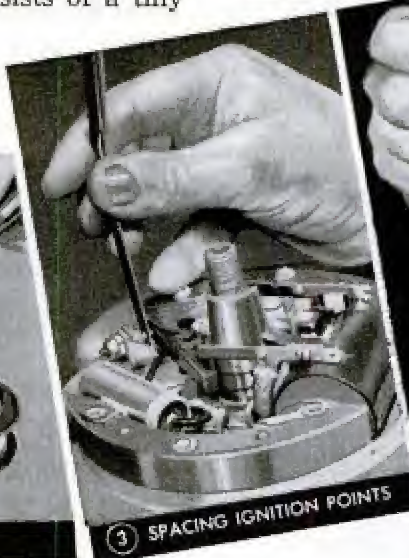
① REMOVING NUT THAT TIGHTENS FLYWHEEL



② TIGHTENING THE CONDENSER



③ SPACING IGNITION POINTS



④ IGNITION WIRE SOLDERED

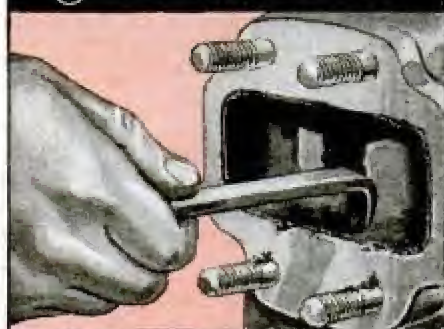




⑥ CORK FLOAT TO BE RECOATED



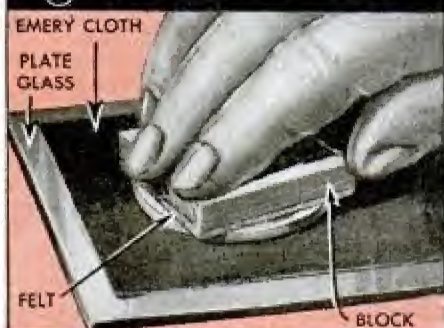
⑦ RESOLDER LOOSE METAL FLOAT



⑧ SCRAPING EXHAUST PORT CLEAN



⑨ CHECK RING-GROOVE CLEARANCE



⑩ PISTON RINGS LAPPED



⑤ SHELLACKING GASKET



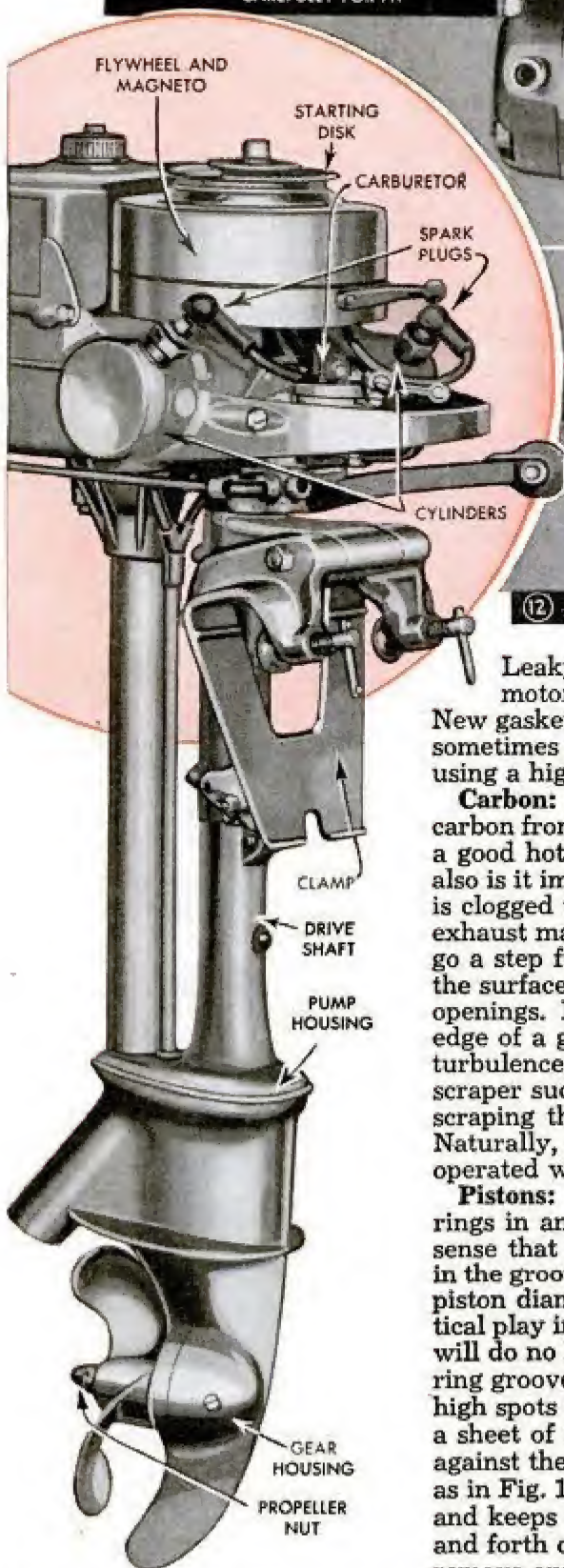
of hard grease applied to the cam which is an integral part of the crankshaft. If starting has been difficult, it is a good idea to take the flywheel to an authorized outboard-motor service shop and have the magnet recharged.

After several seasons of use, constant flexing of the high-tension wires, as a result of advancing and retarding the spark, may cause insulation cracks which lead to loss of spark. If available, new wires should be installed as in Fig. 4. In soldering electrical connections always use non-corrosive flux—never acid flux! When testing the spark of an outboard magneto it is important that the ignition wires be held not more than $\frac{3}{8}$ in. from some metal part of the motor to which the spark may jump. Cranking the magneto with the wires hanging in space invites a breakdown in the insulation of the coil.

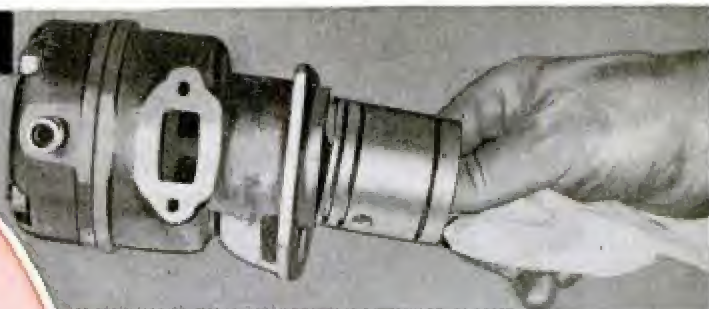
Carburetors: Sometimes the shellac coating on cork floats gradually deteriorates, allowing fine particles to loosen and clog the carburetor. Then the float also loses its proper buoyancy and cannot control the gas flow. The permanent cure for this condition is to remove the float and allow it to dry thoroughly. After this, any loose particles should be sanded off and the entire float given two thin coats of shellac, Fig. 6. Also, it is not unusual to find floats disconnected from the arm, with the result that the carburetor shuts off all fuel, and operation becomes impossible. As this type of carburetor has a metal float, the cure is to solder the float back onto the arm, Fig. 7. Any metal float that has a leak should be pierced with a needle opposite the leak, so that all the liquid and fumes can be blown out. Then the hole and original leak should be soldered, using as little solder as possible to avoid reducing the buoyancy of the unit.

Compression: Although everyone realizes the importance of compression in the combustion chambers, the necessity of compression in the crankcase of a two-cycle outboard motor often is overlooked. Without this compression, the fuel charge is not delivered effectively to the cylinders. A simple check for crankcase compression is to remove all the spark plugs and then crank the motor. You should be able to feel very slight compression in the crankcase and to hear a definite "popping" sound.

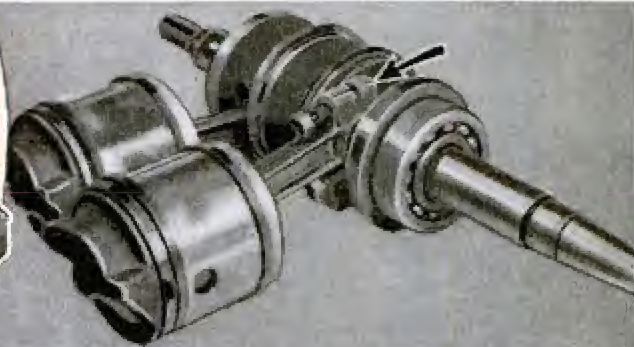
11 NEW PISTONS SHOULD BE CHECKED CAREFULLY FOR FIT



13 ARRANGEMENT OF PARTS ON TYPICAL OUTBOARD MOTOR



12 MARKS FILED ON HALVES OF CONNECTING RODS BEFORE PARTING

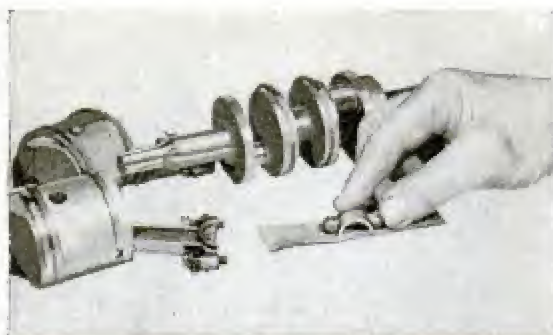


Leaky gaskets, loose bearings or shaft glands in some motors can totally destroy crankcase compression. New gaskets should be installed, or if these are unavailable, sometimes the old ones can be made compression tight by using a high grade gasket cement as in Fig. 5.

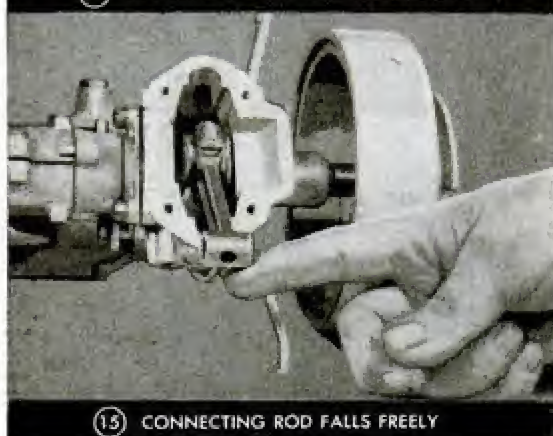
Carbon: One of the most essential services is removing carbon from the exhaust system, Fig. 8. As one cannot build a good hot fire in a furnace that is clogged with ashes, so also is it impossible to get good operation from a motor that is clogged up with carbon. It is not difficult to remove the exhaust manifold and scrape the exhaust ports. Some even go a step further and streamline the passages by polishing the surfaces in the exhaust opening as well as in the intake openings. In streamlining the gas passages be sure that the edge of a gasket does not project into a passage and cause turbulence, thereby restricting the flow. Frequently a hand scraper such as is used for fitting bearings proves useful in scraping the edge of port or piston for perfect alignment. Naturally, care must be taken to see that the motor is not operated with any metal particles left in the cylinder.

Pistons: Contrary to popular opinion, the pistons and rings in an outboard motor do not need to be tight in the sense that they butt closely at the ends or fit very snugly in the grooves. An end gap of .004 to .005 in. for each inch of piston diameter generally will prove satisfactory, and vertical play in the grooves of as much as .004 or .006 in., Fig. 9, will do no harm provided the rings are not warped and the ring grooves are not rough. Lapping piston rings to remove high spots is done on a piece of plate glass on which is held a sheet of fine emery cloth. The ring is pressed uniformly against the cloth by a small block of wood padded with felt as in Fig. 10. The felt assures uniform pressure on the ring and keeps the block from slipping. Working the ring back and forth over the fine emery in a figure-eight pattern will remove any high spots. Obviously this operation should be done only to the amount required to get a true surface.

Prior to removing any part from a motor, it is well to mark the part on an unfinished surface so that there will



14 DRESSING CAP ON CONNECTING ROD



15 CONNECTING ROD FALLS FREELY

be no question about returning it to its original location. As indicated in Fig. 12, this is especially true when removing connecting-rod bearings which should be marked lightly with a file or sharp center-punch before being taken from the shaft.

Should it be necessary to install new pistons, be sure they have proper clearance, Fig. 11. Since fitting a piston too tight can cause serious trouble, installation of new pistons should be left to outboard mechanics. While in automotive service a "rule-of-thumb" way of checking pistons is to figure on .001 in. of clearance for each inch of piston diameter, the average clearance for outboard work will be more nearly .0015 in. for each inch of piston diameter. Finally, after the rings and pistons have been fitted, the owner who wants peak performance follows the example of outboard racing drivers and laps in the pistons and rings with a creamy paste consisting of a soft abrasive window-cleaning powder and light engine oil. This paste is dripped in through the port while the motor is being cranked with power applied generally by a heavy-duty electric drill or a lathe, continuing to run the motor in this way until all surfaces have a fine finish and there is no drag anywhere. Then, the entire motor is dismantled, after which all traces of the abrasive are washed out thoroughly with gasoline.

Connecting rods: Fitting connecting rods is something that the mechanically inclined owner can do himself, and when there is unusual clatter in a motor it may suggest that the bearings should be tightened. Rod adjustment can be done by facing the bearing halves as seen in Fig. 14. Too tight a fit must be avoided. While no noticeable play should be present in the rod when properly fitted, still there must be absolutely no drag, and the rod must fall freely of its own weight when checked on the tip of the finger as in Fig. 15. One thing that certainly will damage a motor results when the lock ring at the end of the wrist pin works loose. Continued operation after this has developed will be certain to ruin the piston and cylinder. Consequently, when working on any motor, it is most important to see that the ring, Fig. 16, is securely snapped into position. When operating a motor that has an unusual noise it should be checked immediately or it may be damaged beyond repair. If your outboard develops a sing-



16 LOCK RING OF PISTON PIN SET IN POSITION

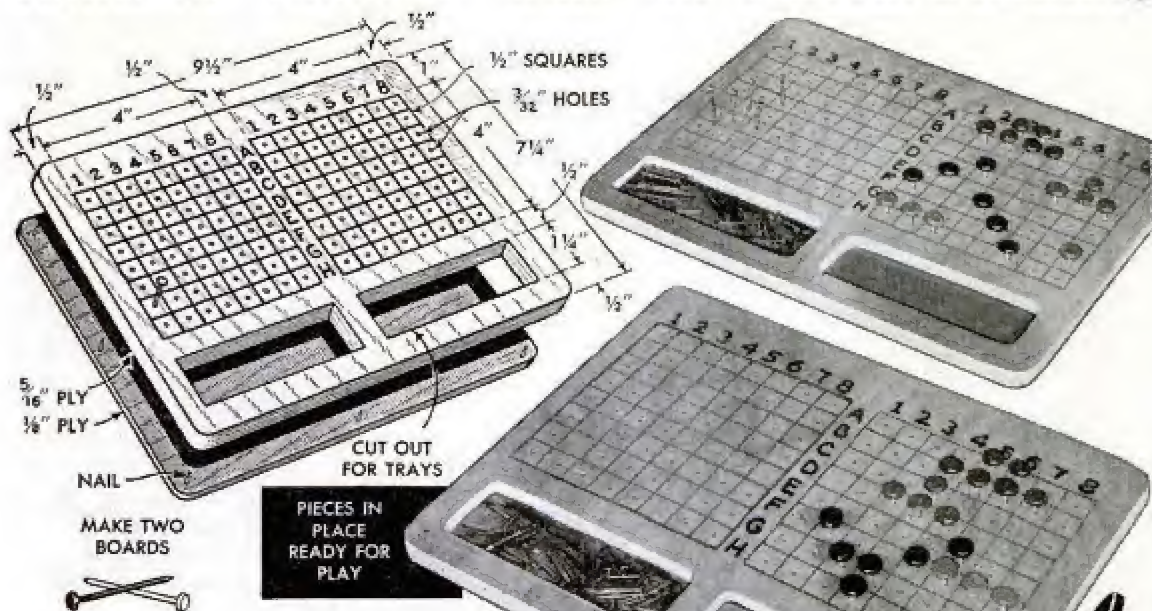


17 CHECK THREADS OF PROPELLER SHAFT

ing sound, by all means check the lubricant in the lower housing or you may soon have a set of junk gears.

Propeller: And while on the subject of servicing the lower end of the motor, it sometimes happens that forcing the propeller nut on too tightly injures the threads on the propeller shaft, Fig. 17. When this has happened, it may be possible to clean them up a bit by using a three-corner file.

Game of "Bomber" Calls for Careful Planning



If you like a pastime with a touch of war atmosphere, try "Bomber," a game for two players, each having a board. Arrange the pieces on the right hand side and use the left to keep account of your opponent's attack. By this means you can quickly grasp the general pattern of his offensive and shift your pieces out of range. To start the game, call out a number such as D-5. If your opponent has part of his force in that square, he announces a hit; if not, a miss. If you score a hit, he must remove that piece from his board. If you hit "Blabbermouth" your opponent must

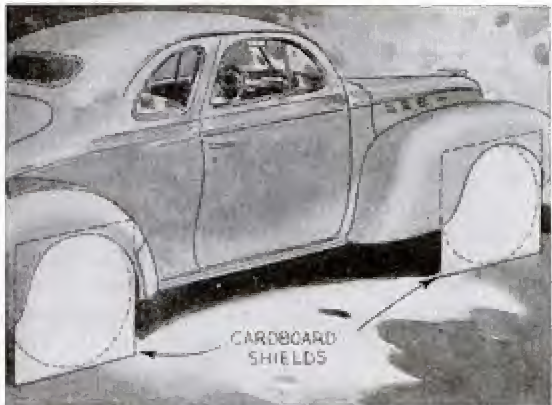
PIECE	SHAPE	COLOR
1 CRUISER		GREEN
1 SUB		BROWN
1 BATTLESHIP		GRAY
2 PLANES		1 BLACK 1 RED

"BLABBERMOUTH" IS THE TRAITOR WHO TELLS WHERE YOUR FORCES ARE

tell the position of any piece you name and remove it from the board. "Blabbermouth" is then placed in a new position. The pieces can be made from upholstering nails with the heads painted as specified. Each board requires twenty 1-in. brads painted red to serve as markers for hits, and unpainted brads to designate misses.

Tires of Parked Car Shielded Against Exposure to Sun

One worker who had to park his car where the tires would be exposed to the sun's rays, which rapidly deteriorate rub-



ber, protected them with shields. These were nothing more than pieces of heavy cardboard cut to a suitable size and slipped up under the fenders. When not in use, the shields were carried inside the car trunk.

Scroll Saw Sands Irregular Work

Sanding small irregular or curved pieces is much easier if the job is done with a strip of abrasive paper substituted for the blade in a scrollsaw. If sandpaper without fiber backing is used, two strips of the paper should be glued together back-to-back for strength. Metal objects may be finished in the same way if emery cloth is used in the scroll saw.

—W. Piland, Portsmouth, Va.

Deckle Edges on Enlargements Made With Blotting Paper



It's easy to make attractive deckle edges on your enlargements if you tear strips of blotting paper and fasten them to the masking arms of your enlarging easel as shown. Blotting paper is recommended since it tears with a good feathery edge. If the blotting paper is scored about half way through with a sharp knife, it will tear easily along a straight line.

L. Robert Luttrell, Chicago.

Lens Cover Will Be Removed If Hooked to Carrying Strap

A popular type of 8-mm. movie camera is supplied with a rubber lens cap so designed that when the cap is removed from the front of the lens it cannot be lost or misplaced accidentally. To avoid any possibility of forgetting to remove the cap be-

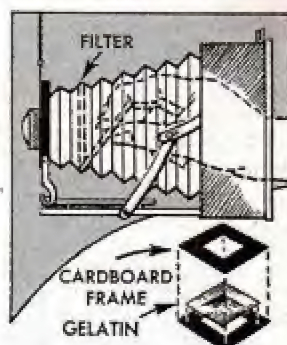


fore using the camera, it is a good idea to loop the camera carrying handle across the rubber band that connects the cap to the lens base as shown. In this way, the cap will be removed when the carrying strap is used to hold the camera during exposure.

—Roland Swedlund, Buffalo, N. Y.

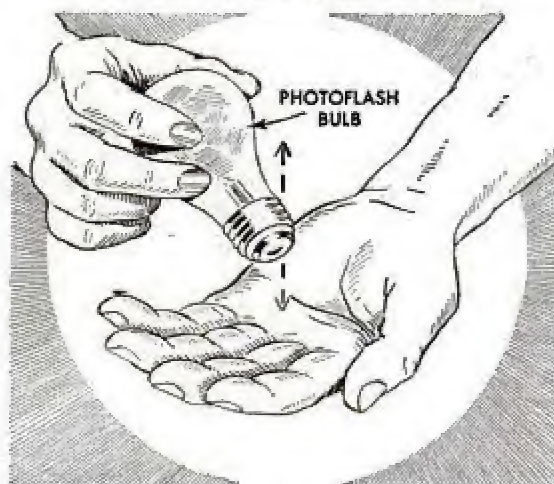
Gelatin Filters Used Behind Lens In Ground-Glass Cameras

Inexpensive gelatin filters can be used with ground glass cameras by placing the filters inside the bellows behind the lens. Framed with cardboard or tape, the filters will fit snugly into the folds of the bellows. Of course, care should be taken to remove the filter before folding the camera.



—H. Klein, Pittsburgh, Pa.

Faulty Photoflash Bulb Repaired By Jarring It on Hand

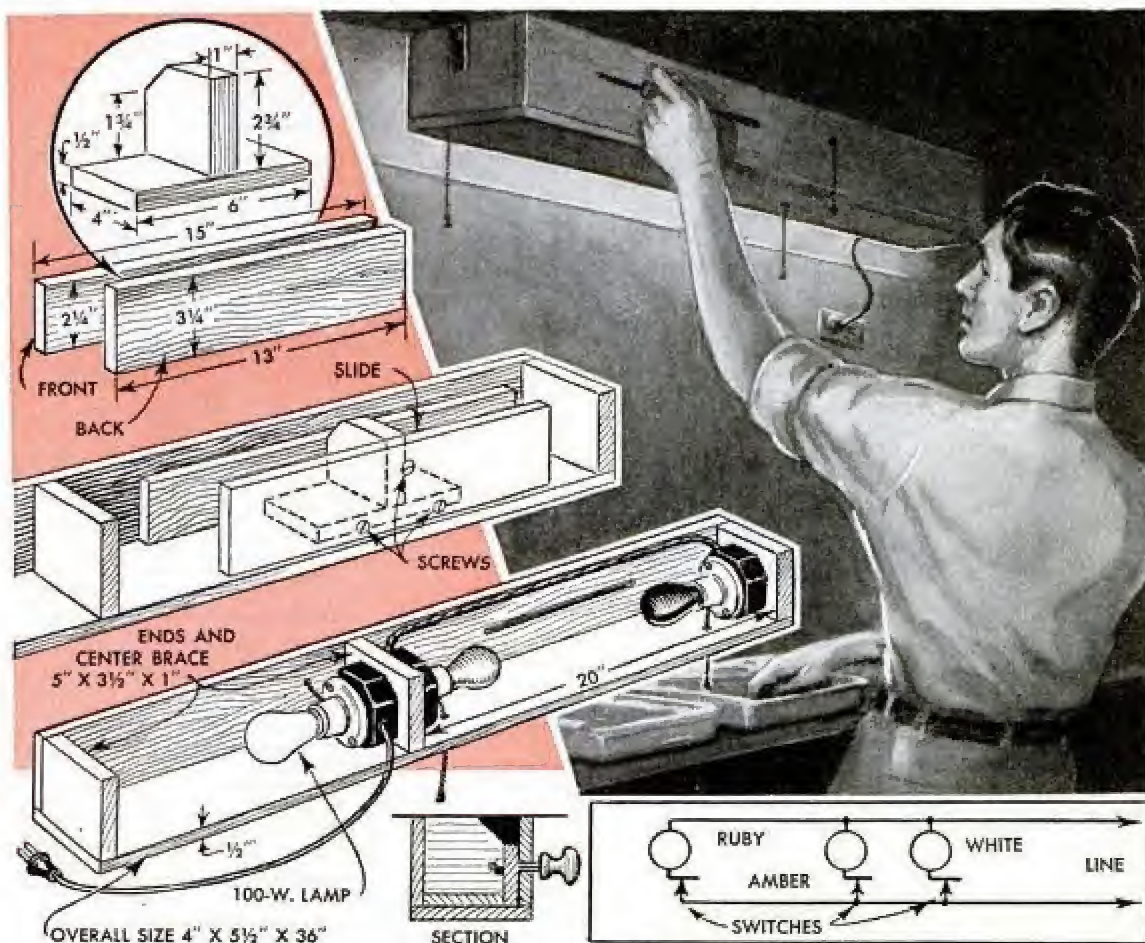


Don't throw away a photo-flash bulb simply because it doesn't go off when it should. Often you will find that "banging" the screw base part of the bulb against the palm of the hand will bring the foil into contact with lead-in terminals and the bulb will thus function as it should.

—Don Mario, Providence, R. I.

☞ For embossing prints, place the photograph to be embossed on a plywood square or whatever you use to make the indentations and run your print roller over it. The roller will not be harmed for its original purpose by the slightly uneven surface.

Darkroom Lamp Provides Variable Light Control



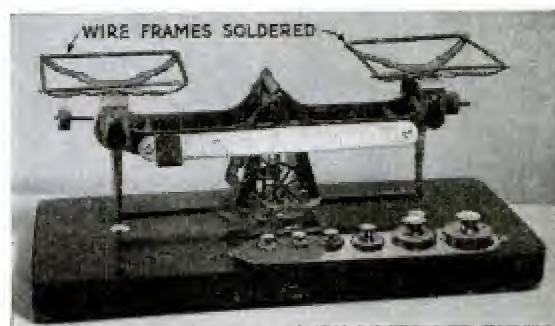
In this darkroom lamp, the intensity of illumination from the amber and ruby lights is controlled by a sliding compartment operated from the front of the housing. Illumination is indirect, permitting a greater allowable brilliance without fogging the work than would be possible with direct light. A 100-watt bulb also is provided to give general illumination over the darkroom bench. Note that all three lamps are controlled individually by pull-chain sockets. Chains for the amber and ruby

lights extend through the bottom of the housing, while the chain for the white light extends through the front for easy identification. Before assembling the housing, mount and wire two sockets on the center partition and one on the endpiece. The sliding compartment is placed in position with the 15 by 2 1/4-in. side against the inside of the front. Install a knob through a slot in the front, taking care to attach it so that there is no binding.

—J. C. Coombs, Evanston, Ill.

Weighing Papers Used on Scales Fitted With Wire Frame

Photographic chemicals can be weighed more conveniently if heavy wire frames are soldered to the prongs of the pan holders. This will enable you to use folded weighing papers more easily. These are merely squares of paper folded twice diagonally. With this method a fresh sheet of paper can be used for each chemical, avoiding the accidental mixing of two chemicals. Chemical powders pour more easily from the papers, which also "center" better on the scales, making for greater accuracy.



Rod Shield on Drawing Board Prevents Soiling Long Work



On many drafting jobs it is necessary to use large sheets of paper that hang over one end of the drawing board. In such cases the worker often has to stand in an awkward position to keep from soiling the overhanging paper. To prevent this and to make his working position more restful, one draftsman uses a shield at the front of his board. The shield is an iron rod bent to shape and inserted into holes drilled into the edge of the board as indicated.

Utilizing Waste Space in Closet Built Over Stairway

If you have a closet built over a stairway leading to the basement or to an upper floor, and the stair ceiling runs at an angle through the lower part of the closet, a drawer can be built in to utilize the waste

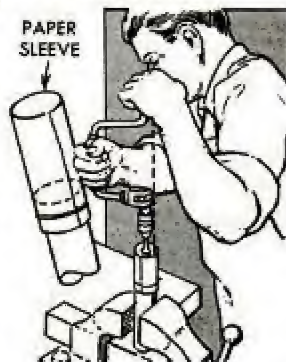


space between the stair ceiling and the raised floor in the closet. You will find many uses for such a drawer, such as a clothes hamper, a place to store extra bedding, etc.

—Kenneth Matthews, Baltimore, Md.

Guide to Bore Straight Holes With a Brace and Bit

Having a number of wooden rollers, in the ends of which I wished to bore holes with a brace and bit, I used a paper guide like the one shown to help assure that the holes would be straight. The guide consisted of a sheet of paper wrapped around the end of the roller to project a few inches beyond its end. With this arrangement, I could keep the drill centered in the paper cylinder fairly accurately by merely sighting down over the brace.



—A. H. Waychoff, Phoenix, Ariz.

Data on Tires Kept in Hub Cap



One motorist who keeps a record of his tire purchases, repairs, etc., prints this data on paper disks, which are cemented to the inside surface of the hub caps. As most caps fit tightly enough to exclude dust and water under ordinary

conditions, the data is safe and always at hand for reference whenever desired.

Mending Aluminum Ware With Ball-Peen Hammer

You can repair tiny holes in aluminum ware easily by placing the worn part over a small anvil or the head of a bolt held in a vise and hammering on the outside of the hole with the ball of a small ball-peen hammer. Aluminum is malleable enough so that this treatment will close the hole and also bend the worn portion of the bottom slightly so that it no longer takes the wear. This method is much simpler than reaming out the hole and mending with the bolt-and-washer system.



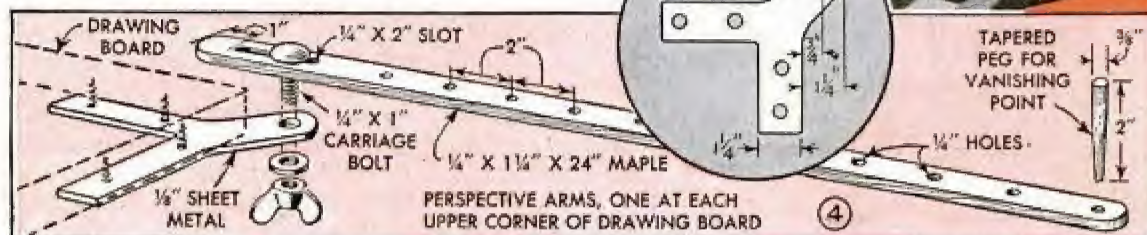
SHOP NOTES



DRAWING DESK *has all conveniences*

By Frank Hegemeyer

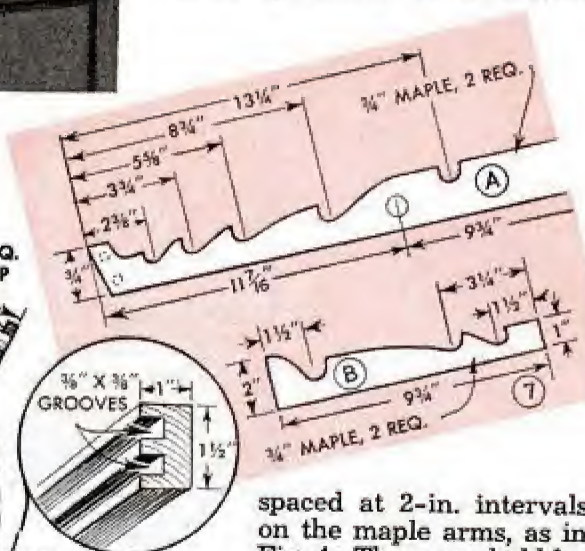
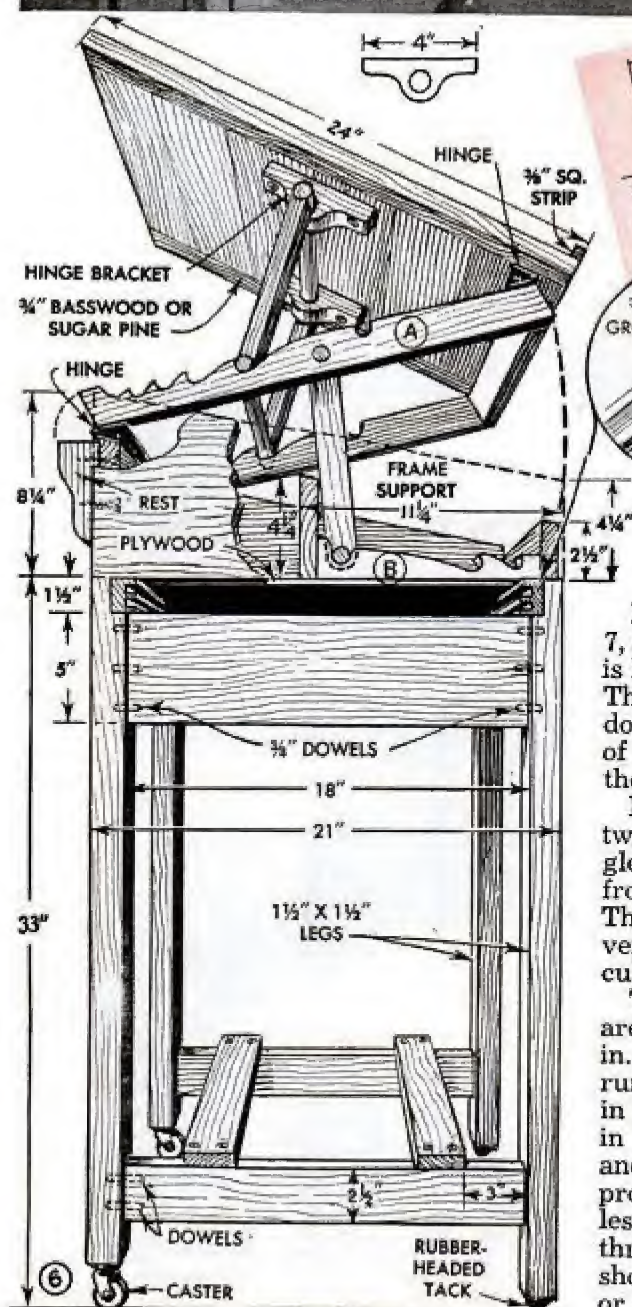
DRAFTSMEN will find this drawing desk sturdy and convenient. The drawing board can be adjusted to eighteen different positions, and vanishing points are established by means of movable side arms, as illustrated in Fig. 1. Also, there is a built-in compartment with opal glass and lights for tracing, shown in Fig. 2, and three roomy compartments for storing full-size blueprints and other bulky material, besides a drawer to hold equipment.





A drawing board of the proper size can be purchased, or one can be made by joining six pieces of basswood or sugar pine with the heart and sap sides alternating to minimize warping. The ends should be grooved for a maple spline, and all pieces glued together as in Fig. 5. After the board has been surfaced smooth, a coat of boiled linseed oil should be applied to both sides and edges.

Tapered pegs, which serve as vanishing points, fit into holes

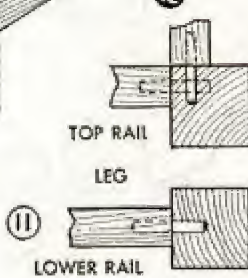
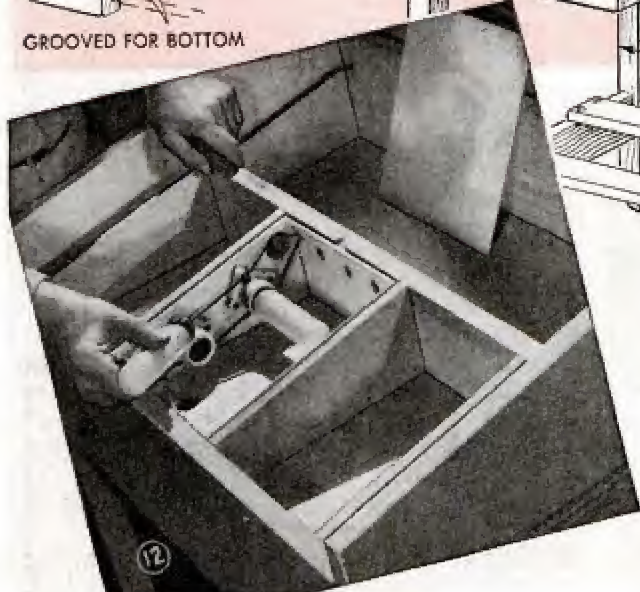
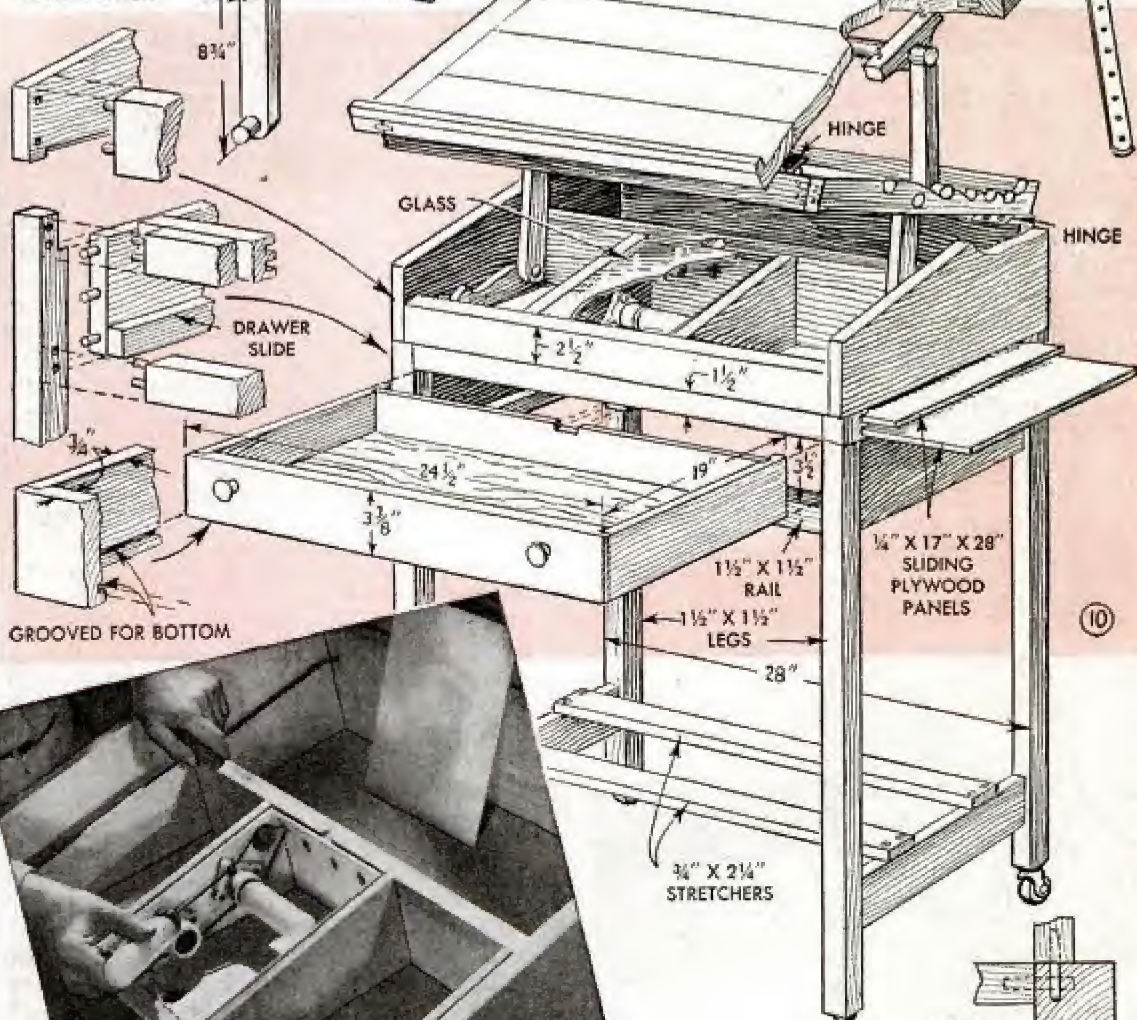
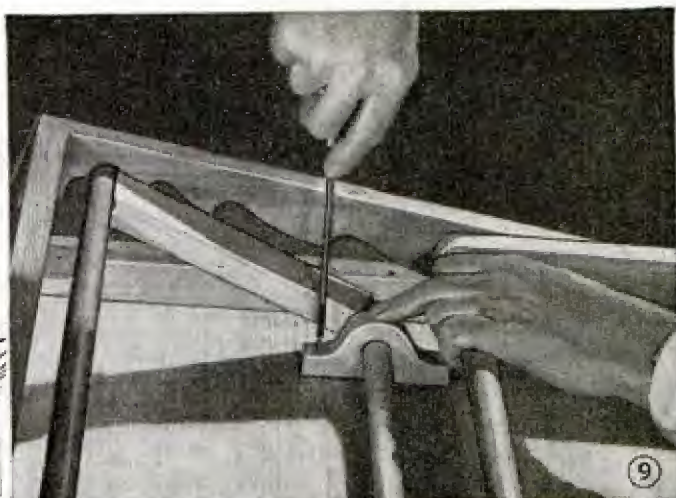
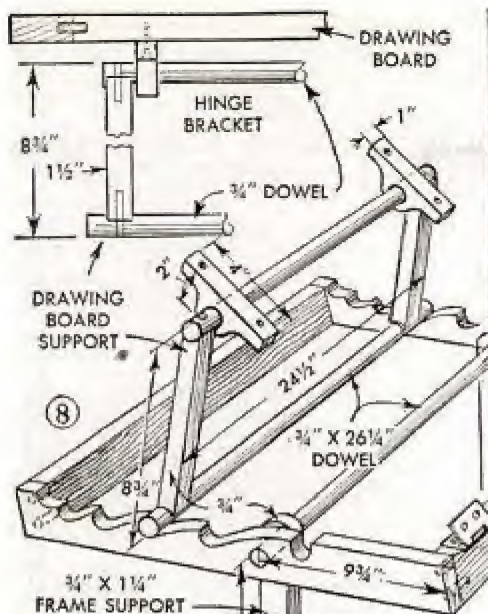


spaced at 2-in. intervals on the maple arms, as in Fig. 4. These are held by bolts and wingnuts to two 1/8-in., sheet-metal brackets screwed to the upper corners of the board, as shown in Figs. 3 and 4.

Pieces A and B, indicated in Figs. 6 and 7, are of maple. Fig. 9 shows how the dowel is held by hinge brackets, one at each end. These are fastened to the board when the dowel is in the 2 3/8-in. notch to give a tilt of 20 degrees. The other notches increase the tilt of the board by 10 degrees each.

For the light box, two porcelain sockets, two 40-watt frosted tubular lamps, a toggle switch, some lampcord and a piece of frosted or opal glass 8 by 10 in. are needed. The inside should be painted white, and vent holes are provided to permit air circulation, as illustrated in Fig. 12.

The front, back and ends of the top part are rabbeted on the bottom edge for a 1/4-in. plywood bottom, and grooved maple runners are inserted in the notched legs as in Fig. 6, to hold the sliding panels shown in Fig. 10. Fig. 11 shows how the upper and lower rails are mortised together to provide sturdy support for the desk. Unless otherwise specified, 3/4-in. pine is used throughout, and all joints are doweled as shown. The desk can be painted or stained, or it can be shellacked and varnished.



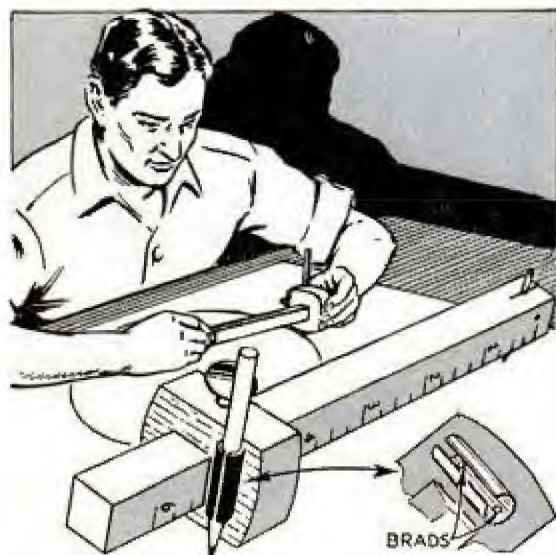
Beveled Pipe Used as Star Drill When Boring Through Wall



When you have to drill through a brick wall and there is no star drill at hand, just bevel one end of a piece of pipe of suitable size and use it as a drill. Of course, it may be necessary to sharpen the pipe frequently, but this can be done in a moment or two if a grinder is at hand. If possible, follow a mortar joint between the bricks and the work will be easier and the drill will not dull so quickly.

Pencil Clip on Marking Gauge To Use It as Compass

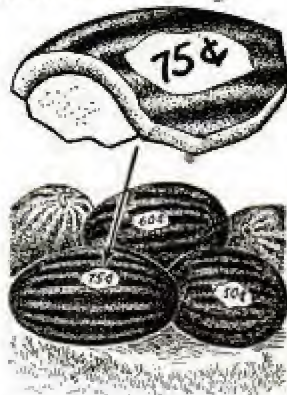
By bradding a pencil clip to the movable part of your marking gauge it can be used as a compass and thus make it unnecessary to carry two tools. The clip is formed from a piece of spring steel. In use, the scratch



pin of the gauge is used as the pivot, and the movable part is adjusted so that the pencil point is at the desired radius.

Scraped Surface on Watermelon Provides Good Price Tag

In stores where watermelons are sold by the pound and therefore may have a number of different prices, just scrape a spot on each melon to expose the white surface underneath. This provides a good background on which to print the price.



Wire to Clean Oilcan Spout Always at Hand



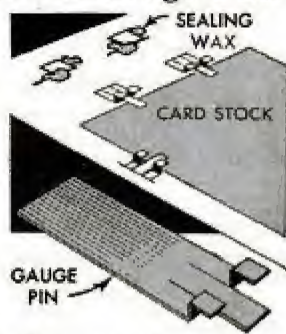
If the spout of an oilcan used around a piece of machinery is clogged frequently by grease and dirt and there isn't a wire handy for cleaning it, just wrap a short piece of wire around the spout as indicated.

In this position, the wire will always be at hand and will not interfere with use of the can.

—John L. Dougheny, Toledo, Ohio.

Making Your Own Gauge Pins

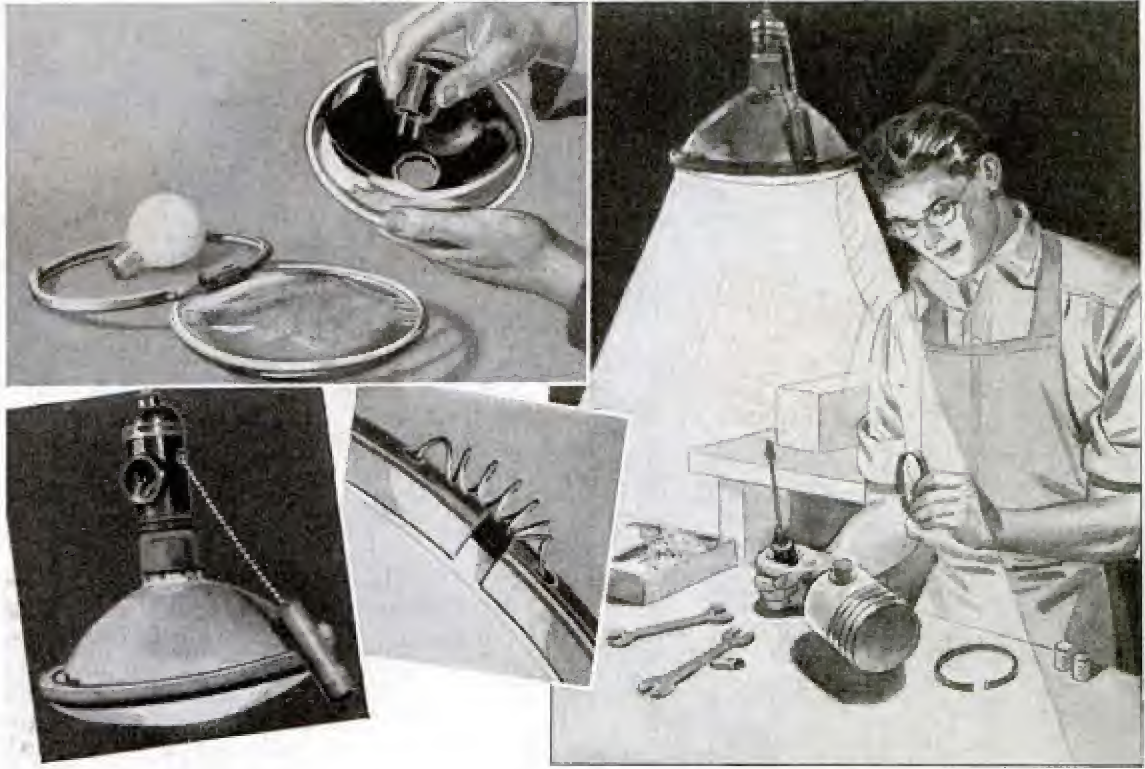
Gauge pins for a platen printing press can be made from ordinary banding iron such as is used to reinforce wooden packing cases and boxes. Short lengths of the iron are cut and shaped at the ends as indicated, after which they are inserted in



slits cut in the drawsheet where they are held by drops of sealing wax. A "shoofly" cut in the drawsheet in front of each pin will aid in sliding card stock against the pins.—Geo. T. Clayton, Los Angeles, Calif.

Wax crayons are excellent for labeling canning jars if used while the jars are hot.

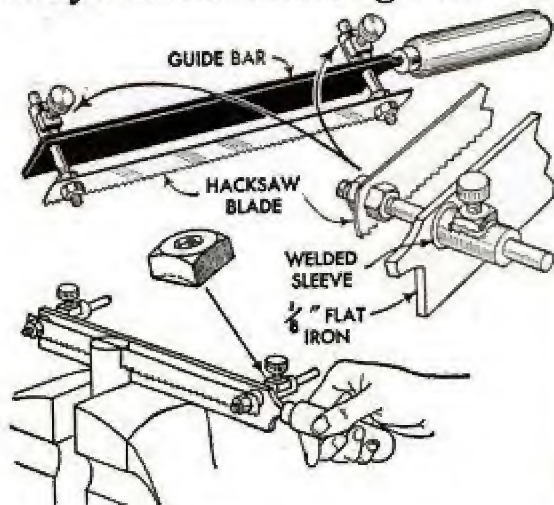
Sealed-Beam Lamp Directs Light on Workbench



For a few cents you can convert a discarded sealed-beam automobile headlight, usually available without charge at garages, into a tarnish-proof workbench light that will concentrate its full brilliance where you want it—right on the work. Use a sealed-beam light of the kind that has a metal reflector. First cut through the soft alloy seal with a hacksaw, remove the glass cover and drive out the old bulb with a punch. The bulb opening can be enlarged easily to fit a plug-in receptacle by cutting back with tinners' shears at $\frac{1}{4}$ -in. inter-

vals and bending the intervening strips with a pair of pliers to break them off. Then the opening can be expanded smoothly by forcing the reflector over the tapered neck of a soda-pop bottle. After inserting the lamp bulb, drill a small hole in each end of the seal, replace the gasket and cover, pull the ends together and attach a piece of wire or a small coil spring to hold them tight. As the lamp has a tendency to concentrate the light in one spot, it should be mounted on an arm pivoted horizontally to direct the light where needed.

Adjustable Slotting Saw Used on Wide Range of Work



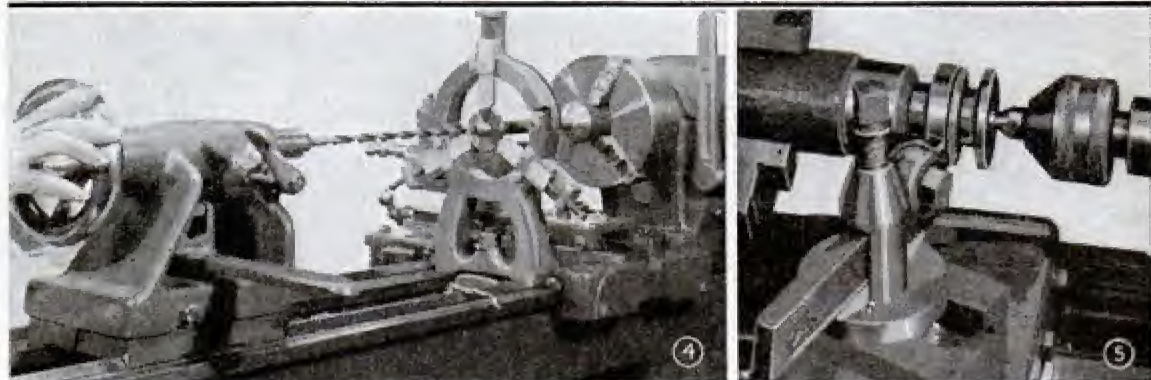
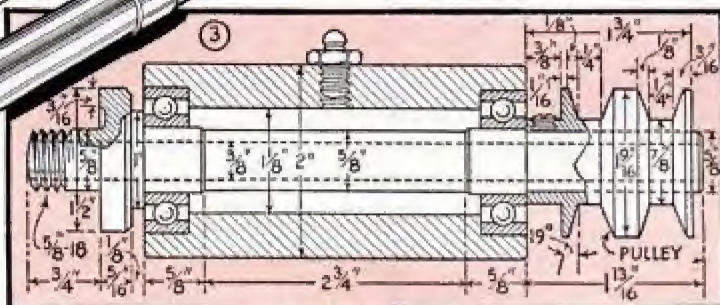
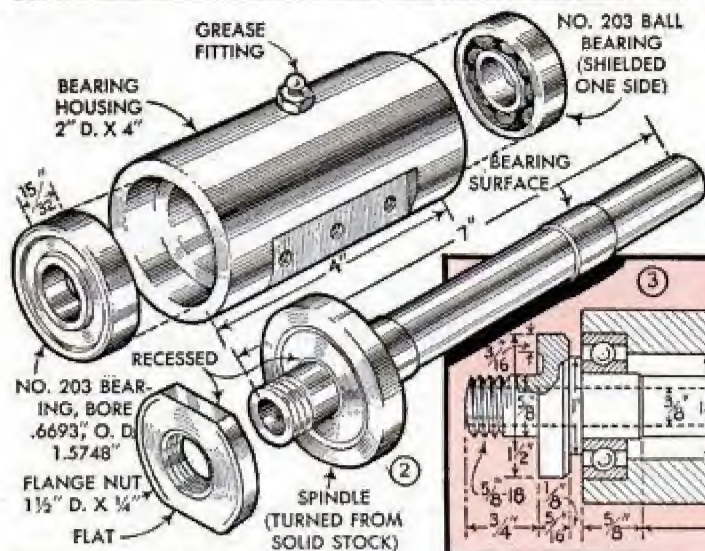
This saw will help assure accuracy and will save you time, especially when slotting a number of duplicate pieces. The saw consists of a hacksaw blade attached to a frame, which serves as a guide bar and from which the saw blade can be spaced as desired. The frame is merely a piece of flat iron cut down at one end to form a tang to take a handle and drilled near each end to receive headless bolts. These are locked to the hacksaw blade by means of nuts on each side of it, and slip through the holes in the frame into sleeves welded to the frame where they are held by thumb-screws. The latter are turned into nuts welded over holes drilled through the sides of the sleeves.



By James Brown

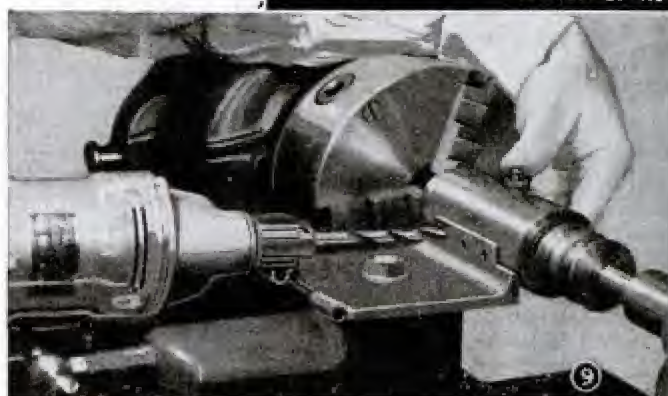
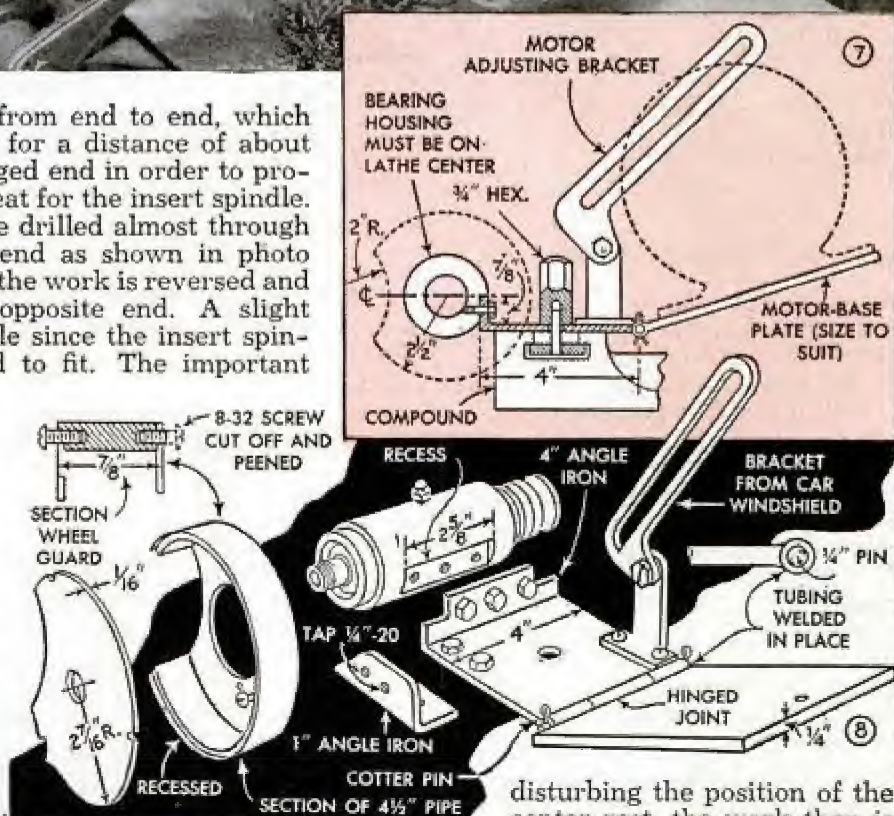
THE tool post grinder is necessary in lathe work whenever a superfine, accurate finish is required, especially if the work is too hard to be turned. The unit described here carries a 4-in. diameter wheel for cylindrical grinding, Fig. 6, and can be fitted with an insert spindle for internal work, Fig. 1. Speeds of approximately 4600 and 7000 r.p.m. are provided, the higher speed being used only for internal work.

Construction is started by turning the bearing housing and spindle as in Figs. 2 and 3. The spindle

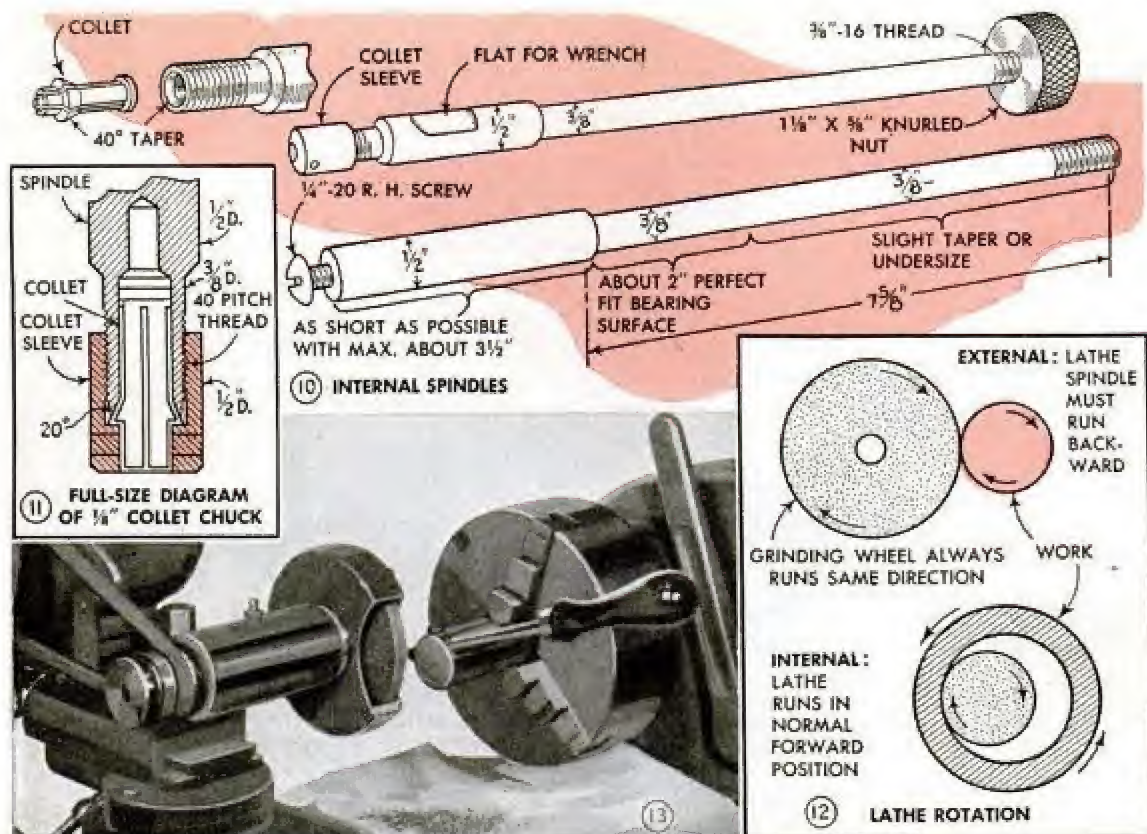




has a $\frac{3}{8}$ -in. hole from end to end, which should be reamed for a distance of about 2 in. from the flanged end in order to provide an accurate seat for the insert spindle. The hole should be drilled almost through from the flanged end as shown in photo Fig. 4, after which the work is reversed and drilled from the opposite end. A slight misfit is permissible since the insert spindle can be turned to fit. The important point is to have both ends accurately centered. For external turning, the bearing housing is mounted in a three-jaw chuck, after which a center rest is used and the center hole and outer bearing seat is turned to size. Without



disturbing the position of the center rest, the work then is reversed for turning the bearing seat at the opposite end. Great care should be exercised in turning all bearing surfaces as the bearings must be a snug, press fit both inside the housing and around the spindle. Ball bearings recommended are No. 203 light duty, with shields on one side. These are standard size in any make and usually can be obtained at automotive supply houses. Bronze bearings may be substituted if desired. The drive pulley



provides the take-up for the spindle and should be faced smooth. Belt grooves are cut with a cut-off tool, setting the compound to cut a 19-degree angle as in Fig. 5.

Figs. 7 and 8 show the assembly of other parts. It is apparent that the grinding wheel must come on the lathe centerline, hence care is necessary in mounting the bearing housing to the angle-iron base plate. Actual setting-up, as shown in Fig. 9, will locate the recess exactly, and the same set-up should be used for spot-drilling the tapped holes. The recess itself can be cut with a milling attachment, or can be ground straight across on a bench grinder. The grinding-wheel guard uses a short length of 4½-in. pipe as a frame, this being fitted with ¼-in. sheet-iron disks on either side. The guard is mounted to the 1-in. angle as shown in Fig. 8, using two, ¼-20 round-head machine screws, the heads of which are ground down to about ⅜ in. thick.

The motor should be no less than ¼ hp. Naturally, you will want the motor as small and compact as possible, but at the same time you need power. A standard ¼-hp. motor, while a bit on the bulky side, is perhaps the best from a performance viewpoint. Drive pulleys should be 4 and 6 in. The belt has a ⅜-in. face, 38-degree vee, with a circumference of about 25 in. The motor-adjusting bracket shown was obtained from an old model car; it works on

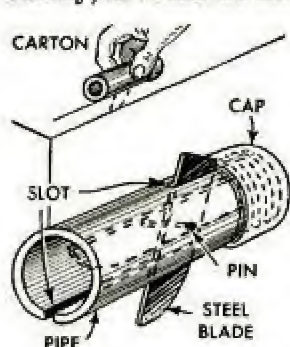
a machine screw threaded into the top motor end bell hole.

Insert spindles for internal grinding can be made up in any of a number of styles, the two shown in Fig. 10 being typical. The top spindle takes wheels with ⅛-in. shanks, and the bottom spindle requires wheels with ¼-in. hole. The collet chuck is perhaps the most useful since it utilizes the same grinding wheels used in the popular hand grinders. The collet and collet sleeve also can be obtained from the hand grinder. Fig. 11 shows this chuck full size. The same pattern, but in a larger size to take standard wheels with ¼-in. shanks, would make an excellent mounting for heavy internal grinding.

In using the tool-post grinder for external grinding on cylinders, the lathe spindle must be reversed, that is, it must run backward. This is accomplished with a standard reversing switch, which should be standard equipment on every lathe. When the job is internal grinding, the lathe runs in normal forward position, Fig. 12. Proper dressing of the wheel, preferably with a diamond dresser, is essential for clean smooth work. Dressing should be done mechanically, not freehand. A simple mounting for a diamond dresser is shown in Fig. 13. A somewhat similar mounting can be made for a square or round stick dresser, which can be used satisfactorily if a diamond is not available.

Safety Knife to Open Cartons

Workmen who have to open cardboard cartons frequently will find this knife handy, as it can be closed and carried safely in the pocket.

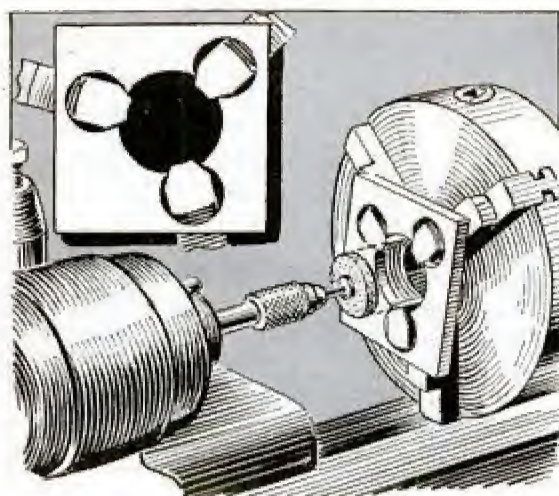


The knife consists of a steel blade pivoted inside a short piece of pipe as indicated, the pipe being slotted on opposite sides at the ends to receive the blade. In fitting the blade, pivot it so that the upper end projects just slightly when the blade is in the cutting position. In this way, two or three turns of the pipe cap at the end will permit the blade to swing inside the pipe where it stays until it is swung out and the cap tightened to lock it in the opened position.

Jig Aids in Grinding Jaws Of Universal Chuck

Truing up sprung jaws of a three-jaw chuck by grinding is a fairly easy job if a jig like the one shown is used to hold the jaws in alignment. However, be sure that it is the jaws that are sprung and not the scroll. First, drill three holes in a piece of plate metal, spacing the holes equally to fit over the outer ends of the jaws. Then bore out the center of the plate between the holes as indicated. Next, place the jig over the jaws and tighten them against the lower sides of the holes, which produces the same effect as tightening them against a piece of work. Now, with a grinder and wheel of suitable size mounted correctly on the lathe carriage as indicated, feed the wheel against the jaws by inserting it into the large center hole in the jig.

—Will D. Candee, Los Angeles, Calif.



One Straight Double Stud Made From Two Warped Pieces

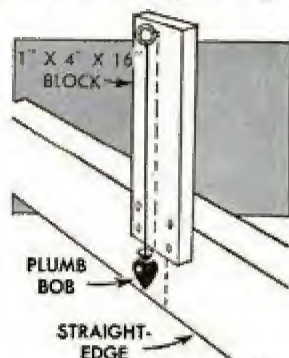


Badly warped studs and other small timbers often can be salvaged by nailing two of the warped ones together and using them where double studs are required. Place the warped pieces one on top of the other with the concave surfaces facing opposite directions. Then, drive a large nail at one end and have a second worker spring the warped ends together as other nails are driven. In most cases a timber thus formed will remain fairly straight.

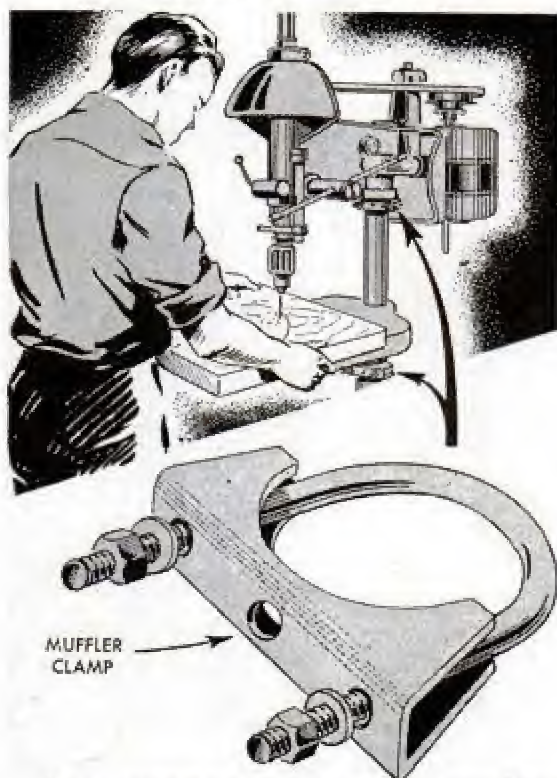
—Frank Beatty, Chicago

Level Improvised on Straightedge

Needing a level on a job where none was available, one workman improvised one by using a plumb bob and a straightedge. A block 16 in. long was nailed exactly at right angles to the straightedge as indicated and the plumb bob was suspended from a screw eye at the upper end of the block. After marking the exact center of the block near the lower end, it was easy to tell when an object was level by bringing the line of the plumb bob directly over the mark on the block.



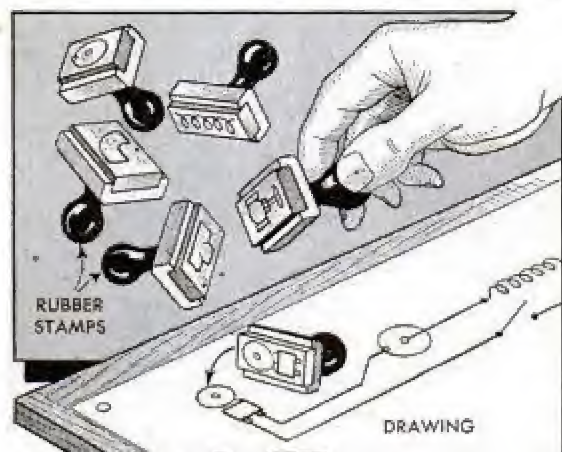
Auto-Muffler Clamp Is Handy On Drill-Press Column



After trying unsuccessfully to purchase a clamp for my drill press to hold the head when swinging it out of the way, I found that a clamp of the type used on auto mufflers was ideal for this purpose. I use these clamps under the drill-press head and also under the table. In this way, I can swing either the head or table around out of the way without disturbing their vertical adjustment.—R. Boettinger, Englewood, N. J.

Artists' Symbol Stamps Save Time When Making Blueprints

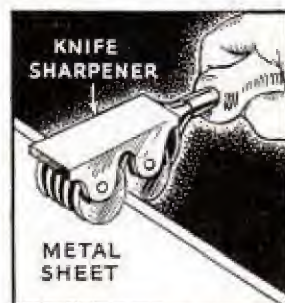
Draftsmen who make up drawings of electrical circuits and do similar work can save time and assure accuracy by using



rubber stamps of the most common symbols used in their work. In this way, they can stamp the symbols in the desired locations on the drawing and then connect them with lines to complete the circuit or other drawing that is being made.

Knife Sharpener Removes Burrs From Edges of Sheet Metal

Used by the employees of a large aircraft company, an ordinary knife sharpener has been found very satisfactory for removing burrs from the edges of sheet metal. Besides performing an efficient job, the sharpener saves time by burring both edges in one operation.



Loss of Identification Badge Avoided With Nail Polish



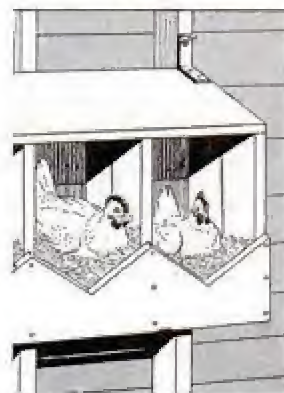
The clasps on some identification badges are so easily disengaged that they are frequently lost. In such cases, a drop of cellulose cement or clear fingernail polish applied to the clasp as indicated will prevent this trouble. The cement

dries quickly to a hard film and can be peeled off easily when necessary to change the badge from one garment to another.

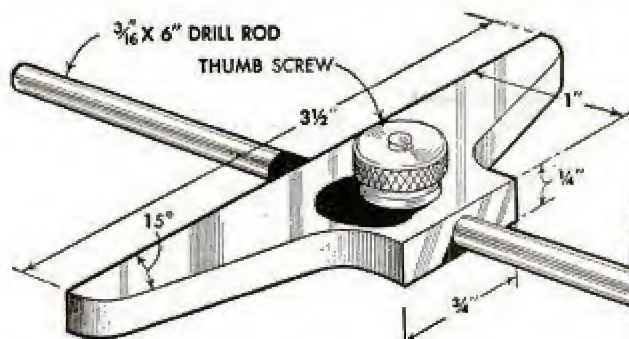
—Ken Murray, Baltimore, Md.

Hens Prevented From Roosting On Edges of Nests

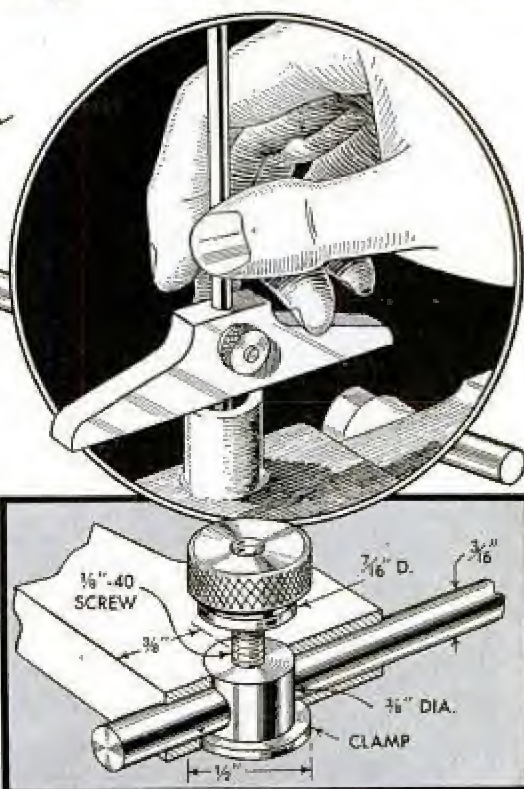
If your chickens have a habit of roosting on the edges of the nests, the trouble can be stopped easily. Just notch the edge of the front retaining board. This will make it difficult for the chickens to perch on it and they will give up the habit.



This Accurate Depth Gauge Is Easy to Make



With this simple depth gauge you can set the spindle accurately and tighten it in place without nicking its polished surface or disturbing the setting, just by turning the knurled thumbnut which pulls up the flanged clamp against the spindle to hold it. After scribing the outline of the beam on a piece of cold-rolled steel, chuck the latter in a lathe and drill a $\frac{3}{8}$ -in. hole $\frac{1}{2}$ in. from the top, and counterbore it to a $\frac{1}{2}$ -in. diameter and a depth of $\frac{1}{32}$ in. for the clamp flange. Next, from a piece of drill rod, turn the clamp with a $\frac{1}{32}$ by $\frac{1}{2}$ -in. flange, and a projecting shaft $\frac{1}{8}$ by $\frac{5}{16}$ in. to form the bolt, and thread it as shown. The thumbnut is similarly turned to size, drilled and tapped for the clamp screw, knurled and cut off. Then the clamp is inserted in the beam with a thin piece of paper placed under the flange to allow for clearance, the hole for the spindle is laid out carefully on the beam end and drilled through both beam and clamp. When the

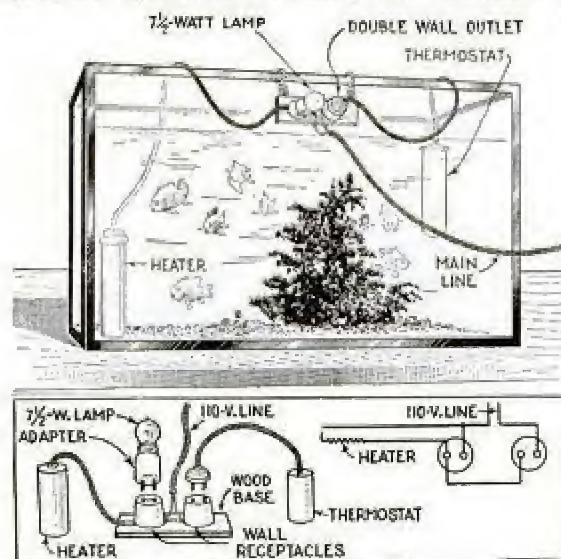


paper is removed from behind the flange there will be a clearance of several thousandths of an inch to allow the clamp to be pulled up tightly against the spindle when the nut is tightened and thus grip the spindle securely without marring it.

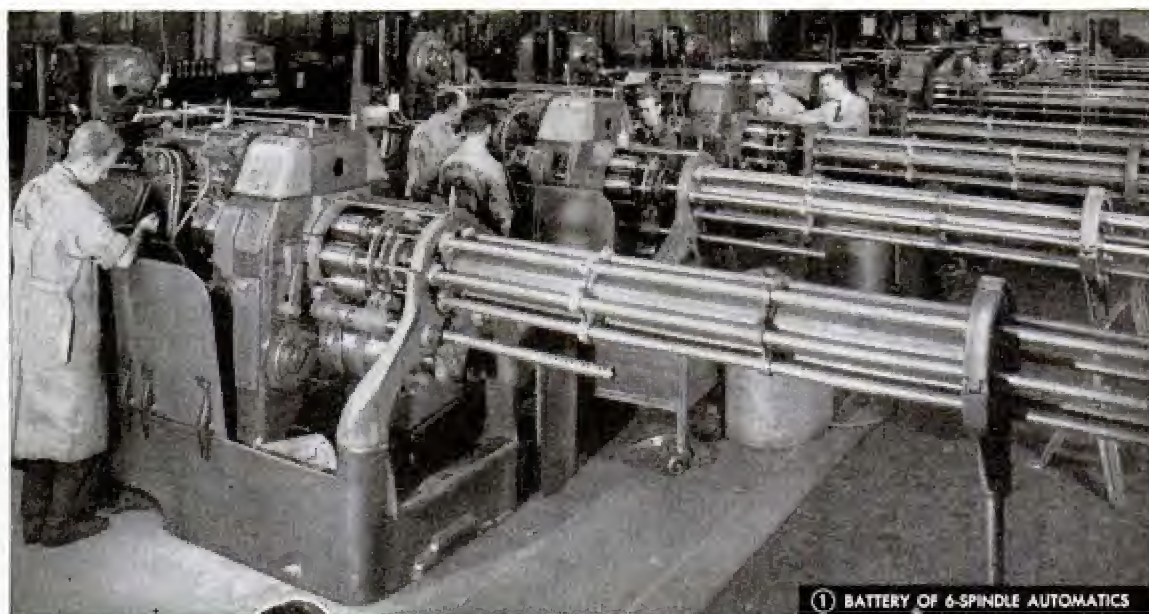
—C. W. Woodson, East Aurora, N. Y.

Aquarium Heater and Thermostat Checked by Pilot Light

If you have lost tropical fish due to failure of the heater or thermostat, you'll appreciate the value of using a pilot light in



the line to determine at a glance when the heater and thermostat are operating correctly. Get a small lamp and a plug-in adapter socket, and two porcelain receptacles of the screw-on type. Wire these to your 110-volt circuit and aquarium heater as indicated in the lower right-hand detail, and attach the assembly to a wooden, plastic or fiber base. The thermostat cord is provided with a plug to slip into the right-hand receptacle and the socket holding the pilot lamp is plugged into the other receptacle, after which the assembly can be hung from the edge of the aquarium on the outside as shown. The lamp will light when the heater is working. If the lamp and heater do not function as often as necessary to keep the water at the proper temperature, the thermostat should be checked as it may be defective or may require adjustment. If the light is on continuously, the thermostat may be working correctly but the heater is not functioning.



① BATTERY OF 6-SPINDLE AUTOMATICS



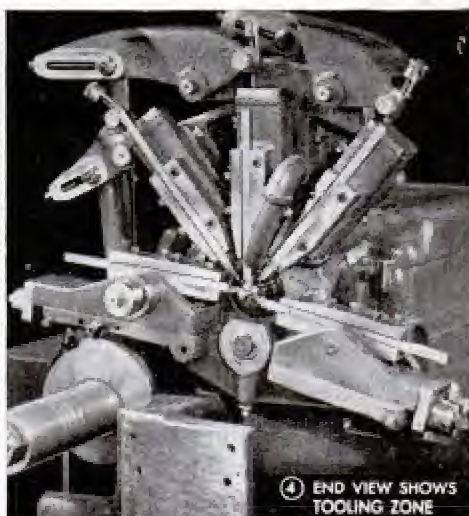
② LATHE SET UP AS HAND-SCREW MACHINE

THE automatic screw machine, originally nothing more than an automatic turret lathe, was first used, as its name implies, for making screws. However, after numerous improvements, this machine has become a complex multiple-spindle lathe used for producing amazing quantities of small turned parts of various sizes and shapes with a high degree of uniform accuracy and at a minimum cost. While some simple parts shown in Fig. 6, which require only a few operations, can be produced at the rate of 6,000 an hour, other parts requiring more operations may take 3 or 4 minutes to produce each.

Material from which the parts are made may be standard round, square or hexagon bar stock. The blank stock is automatically fed to the cutting tools which perform various operations on each piece in sequence. Speeds and feeds of the cutting tools to obtain economical operation



③ ONE-SPINDLE AUTOMATIC



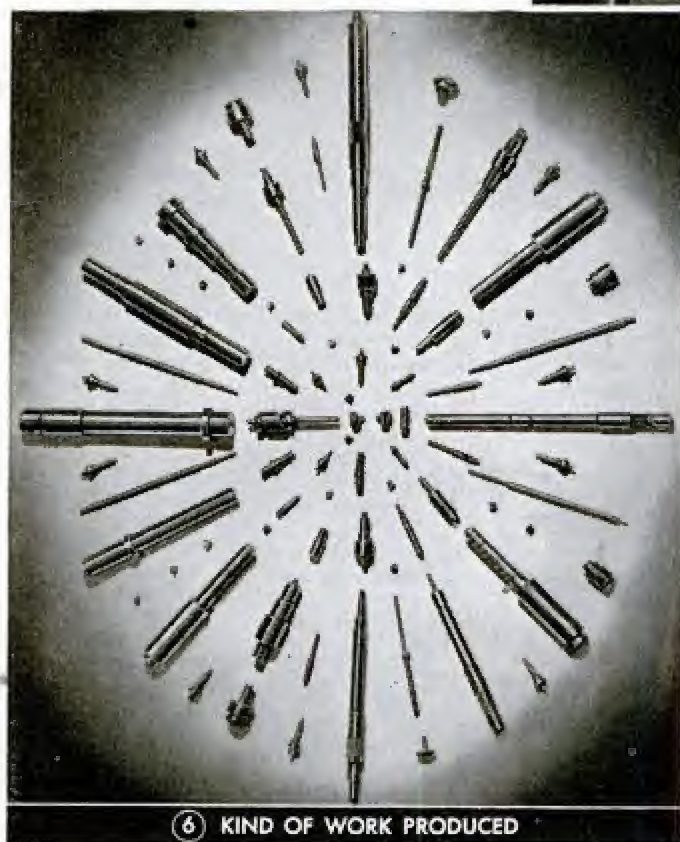
④ END VIEW SHOWS TOOLING ZONE

"Briefing" the AUTOMATIC SCREW MACHINE

By H. J. Chamberland



5 FINISHED
WORK "ROLLING
OFF" 6-SPINDLE
AUTOMATIC



6 KIND OF WORK PRODUCED

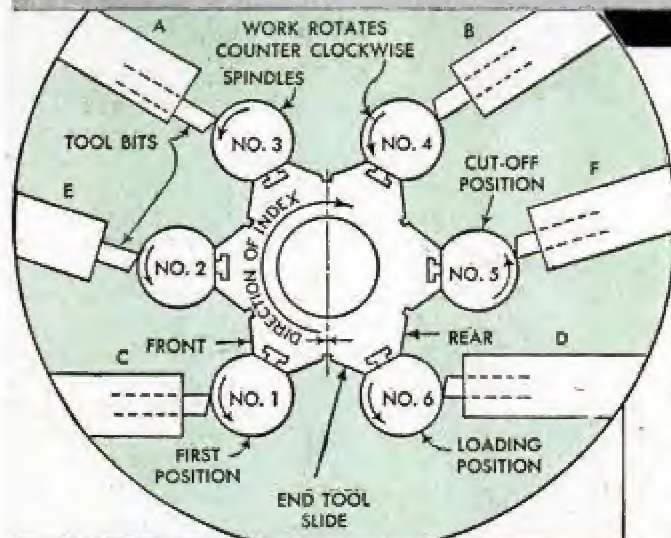
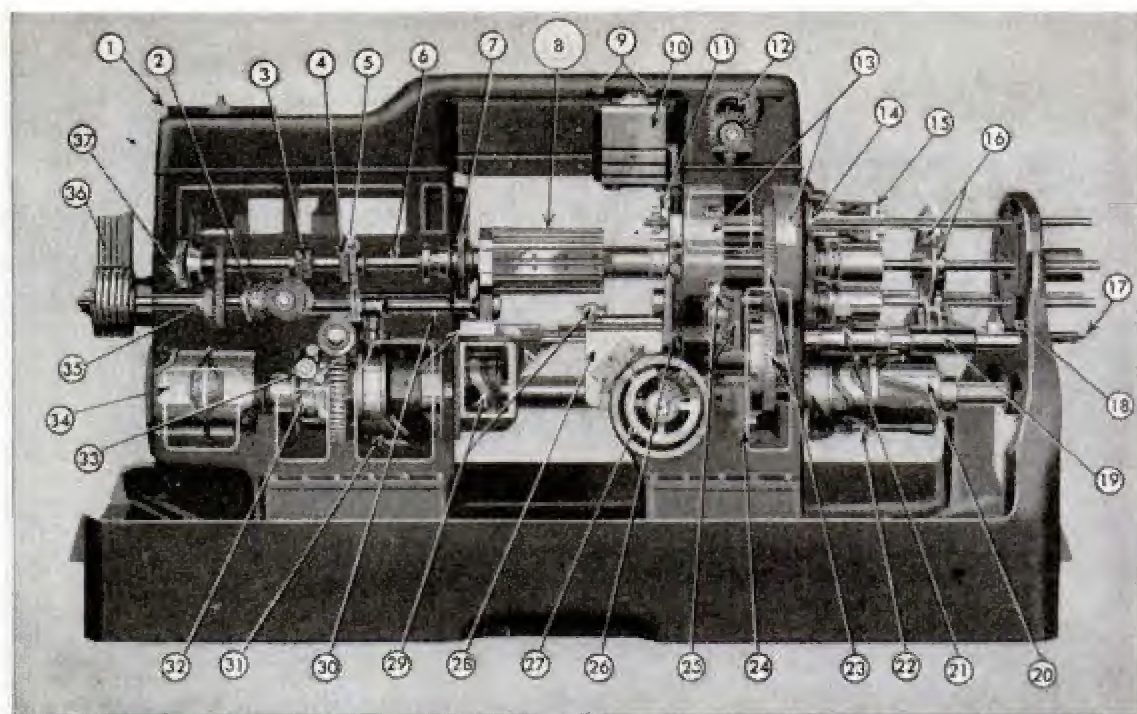
also are varied automatically. Each spindle of a multiple-spindle screw machine holds a bar of stock and the cutting tools are fed forward against stock held in opposing spindles. After finishing its cut, each tool returns to its starting position and the work-spindle carrier or head rotates so that each bar of stock is brought to the next cutting position. After turning, drilling, reaming, counterboring, threading and other operations are performed, the finished piece is cut off. So, on an eight-spindle screw machine a piece of finished work is dropped off with each change of

indexing of the spindle carrier—or eight pieces in a complete rotation. Fig. 1 shows a battery of six-spindle automatics while Fig. 5 shows how finished parts "roll off" such a machine in prodigious quantities. Generally the parts are produced with an average tolerance of from three to five one-thousandths inch, but for high-precision work it is possible to work within limits of two to five ten-thousandths inch.

Turret-fitted lathe: Fig. 2 shows a small engine lathe equipped with a turret, which is the forerunner of the present screw machine. This setup differs from a regular turret lathe in that bar stock for the former

is inserted through the headstock and is gripped securely by means of a spring collet. Regular turret-lathe work applies to the machining of blanks already cut off from large-diameter stock, or else forgings or castings, which are held in jaw chucks, chucking devices and on faceplates.

Single-spindle automatic: This machine, Fig. 3, is the stepping stone between the original turret-fitted lathe and the multiple-spindle automatic. The end view, Fig. 4, shows five positions for tools to machine externally. When drilling, reaming, screw-cutting and tapping attachments are re-



⑧ END VIEW OF SPINDLE-CARRIER ASSEMBLY

⑦ DETAILS OF 6-SPINDLE AUTOMATIC

- | | |
|---|---|
| 1—Motor plate | 21—Chuckling slide |
| 2—Oil pump drive | 22—Chuckling drum |
| 3—Threading sprockets (or gears) | 23—Indexing gears for spindle carrier |
| 4—High speed drilling drive | 24—Indexing arm for spindle carrier |
| 5—Feed clutch lever | 25—Locking pin and lever for spindle carrier |
| 6—Spindle drive shaft | 26—Side slide stop bracket and stop screws |
| 7—Idler gear for high speed drilling attachment | 27—Lower side slide drums |
| 8—End tool slide | 28—Lower side slides |
| 9—Upper side slide drums | 29—Drum operated sliding stock feed stop |
| 10—Upper side slides | 30—End tool slide pusher and guide |
| 11—Spindle collet and pusher | 31—End tool slide drum |
| 12—Intermediate side slide drum drive gears | 32—Drum for high speed clutch, threading clutch and brake |
| 13—Spindle carrier | 33—Worm wheel drive shaft brake |
| 14—Spindle gears | 34—Threading slide drums |
| 15—Finger holder mechanism | 35—Range gears |
| 16—Stock feeding ring and aligning disc | 36—Main drive |
| 17—Stock feeding spring | 37—Spindle speed and feed change gears |

quired they are bolted to the vertical section of the bed. While this type of machine is limited to small-diameter bars, the machining and stock-feeding cycle is fully automatic, each individual tool being timed to take a particular cut. Once the machine has been set up to requirements, all the operator has to do is to insert the stock.

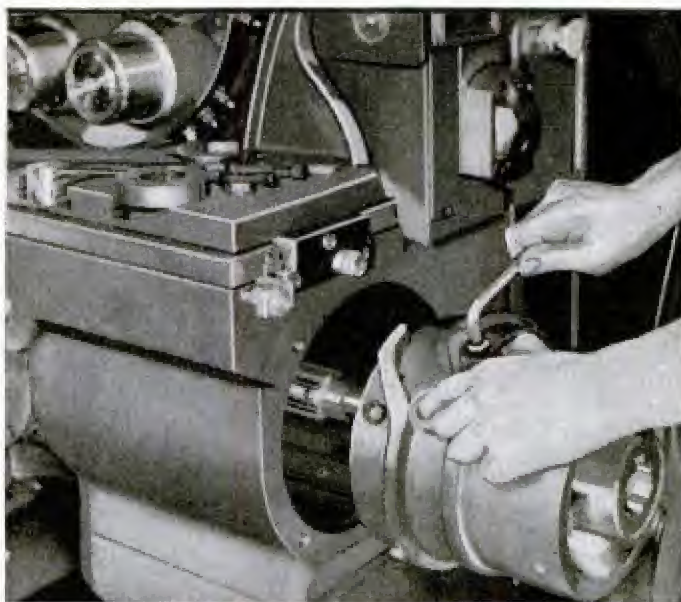
Arrangement and operation of multiple-spindle automatics: The number of spindles (4, 6 or 8) on an automatic screw machine limits the diameter of bars that the machine will accommodate. A 4-spindle machine takes bar stock $\frac{7}{8}$ to $4\frac{3}{4}$ in. in diameter, a 6-spindle takes $\frac{9}{16}$ to $3\frac{1}{2}$ in., and an 8-spindle $1\frac{5}{8}$ to $2\frac{5}{8}$ in. The machines shown in Fig. 1 are 6-spindle units which are most generally used. In study-

ing Fig. 7, which shows the rear view of a six-spindle screw machine, note particularly the location of the end-tool slide, 8. Its relation to the side tooling zone is shown in Fig. 8. A and B are upper side tool slides, C and D are lowers and E and F are intermediates. Tool slides A, E and C function from the front side of the machine

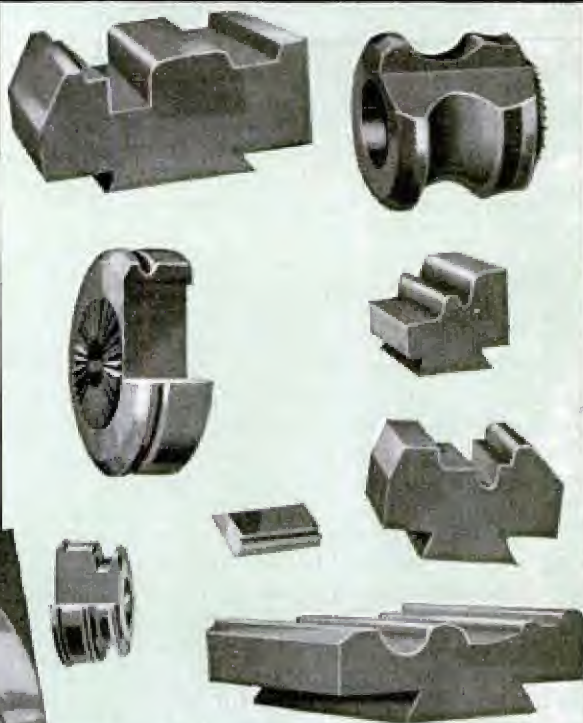
while B, F and D function from the rear. The spindle locations are referred to as working positions and are indicated numerically from 1 to 6 in Fig. 8. Spindles revolve to the left or counterclockwise as viewed from the rear end of the machine. They are driven by gears on each spindle from a central gear on the drive shaft which runs the entire length of the machine, passing through the spindle carrier and its stem.

Bars are loaded into each spindle after indexing the above assembly to No. 1 position. Automatic feeding takes place at the No. 6 position. Then the spindle carrier indexes by steps to bring the bar of stock in each spindle successively into line with the various tools held on the end and side toolslides. The indexing occurs when all cutting tools have been withdrawn from the work.

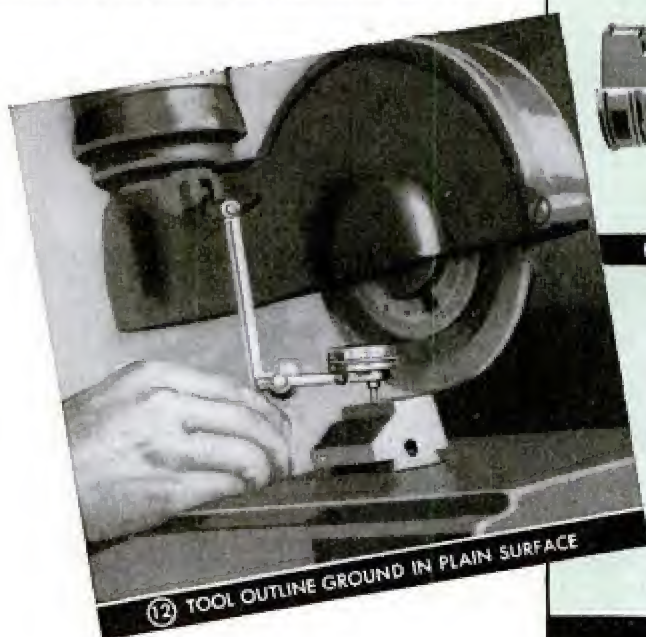
Drilling, reaming, counterboring, screw-cutting and tapping operations, including all customary turning operations, are done from the end tool slide. Provisions are made for the use of die heads and collapsing taps. High-speed drilling attachments also are used regularly and in this case some of the spindles are idled by means of a stopping mechanism. Slotting and cross-milling are operations frequently executed in these machines. All peripheral speeds, timing, depth of cut and amount of feed for each cutting tool are dependent on a network of gear combinations and cams



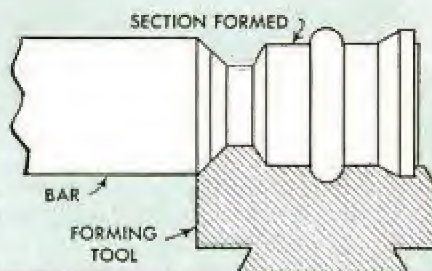
⑨ ADJUSTING CAM OF SIDE SLIDE



⑩ DOVETAIL AND CIRCULAR FORMING TOOLS



⑫ TOOL OUTLINE GROUND IN PLAIN SURFACE



⑪ HOW FORMING TOOL FUNCTIONS

13 SHARPENING CIRCULAR TOOL
ON HORIZONTAL DIAMOND DISK



14 COLORED TIPS IDENTIFY TOOLS

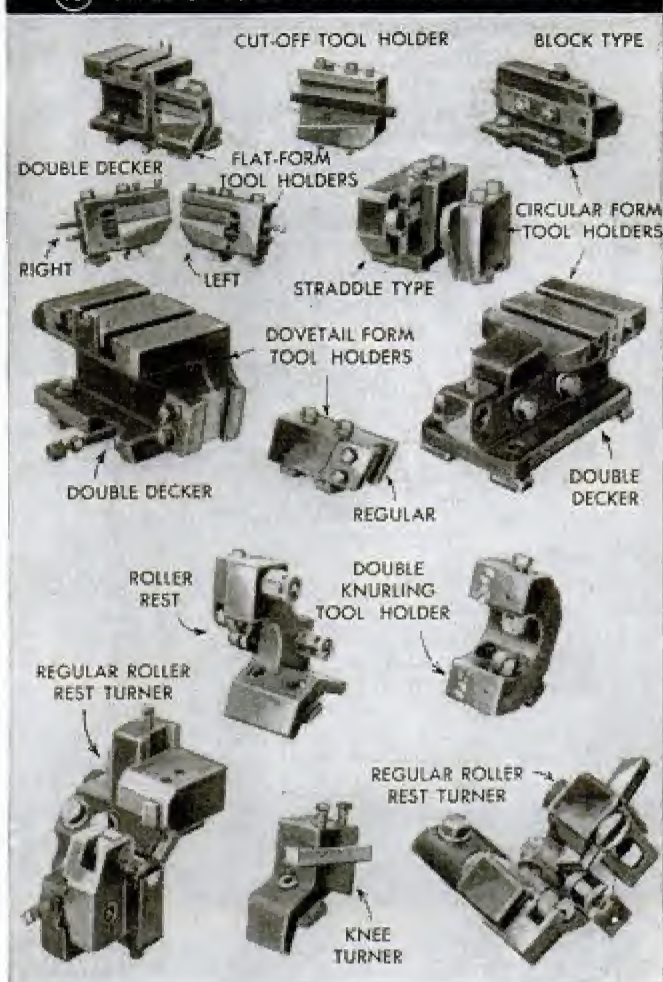
distributed all over the machine. For example, refer to Fig. 9 where the drum related to the rear lower slide has been pulled from the pilot shaft to adjust the cam that will control that particular cutting tool.

Tooling requirements: One advantage of a multiple-spindle automatic is the possibility of dividing long cuts between two or more operations, thus reducing the time the tools are at work for each machining cycle. For example, one tool can be placed behind another in the same T-slot of the end tool slide to perform operations on long work such as drilling and turning at the same time and in the same spindle position. When the design of a piece involves numerous operations, they can be divided between the end and the side tool slides, and may include both roughing and finishing tools in successive positions so they work on different bars simultaneously.

All types of lathe cutting tools are used in screw machines with no change in grinding requirements. However, with multiple-spindle production, dovetail and circular forming tools predominate as they reproduce an external outline which would otherwise require several cuts with different tools. Typical examples of dovetail and circular tools are shown in Fig. 10. Fig. 11 shows how these

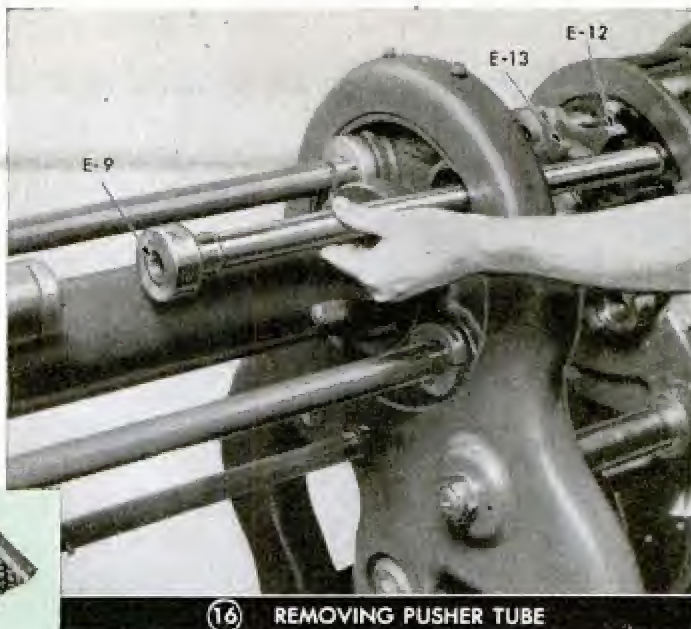
forming tools function, the one shown being a dovetail tool. A roughing and a finishing tool are used frequently simultaneously to avoid retarding other cuts of the cycle. As forming tools are intended for quantity production, a master tool is made first and the working tools are duplicated as needed. In some cases, as shown in Fig. 12, the outline of a dovetail tool is produced by grinding on a straight surface after the tool has been otherwise machined and hardened. This applies to a form where the deepest section is less than $\frac{3}{16}$ in. Fig. 13 shows the cutting edge of a carbide-tipped circular forming tool being sharpened on a diamond-impregnated, horizontally-operated disk. A large number of carbide-tipped cutting tools like the one shown in Fig. 14 are used with screw machines. There are various grades of tips to suit different cuts and materials, and as a safeguard against using the wrong tool, tips are available in different colors. After brazing the tip to the body, the color shown in A is painted on the body at B to assure selecting the proper tool once the color on the tip is ground off.

15 TYPES OF TOOL HOLDERS AND ACCESSORIES



Forming tools require an assortment of tool holders such as shown in Fig. 15.

Setting up a six-spindle automatic: Where batteries of these machines are operated, a number of units are assigned to a set-up man especially trained for this work only after years of operating experience. A good set-up man is a combination toolmaker and machinist who is versatile in tool and machine construction. In most screw-machine shops it is customary for the engineering department to



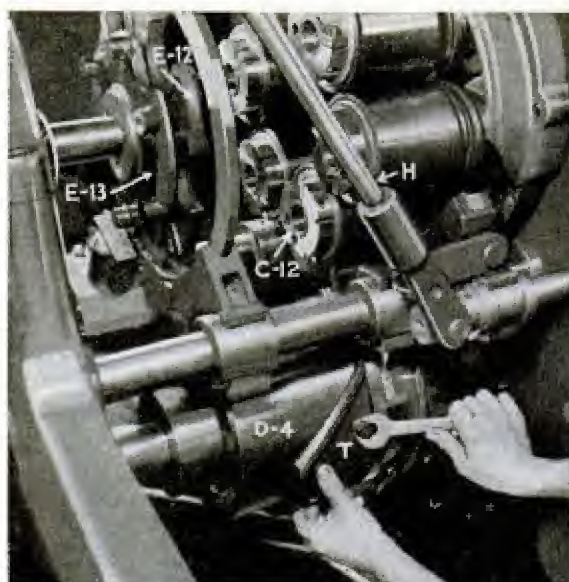
provide a drawing of each part to be machined and its dimensions. Also specified are the spindle speed for the job in revolutions and surface feet per minute, the related gearing, feed change gears, cam adjustments besides all tool holders, cutting tools and other requisites with their respective position in the tooling zone. This information is of great assistance not only to the set-up man, but also to the operator.

The primary step is to fit and adjust the six collets and pushers that automatically grip and feed the bars. Rather than use plain collets it is most economical to select a master type collet as shown in detail A of Fig. 17, in which case it is only necessary to change pads and the same collet can serve for various sizes of bar stock. As collets only chuck the work, master pushers shown in detail B advance the bar after each index and at the 6th or "loading" position. Pushers, often called feeding fingers, grip the bar just enough to carry it the required distance. To fit pushers or the pusher pads only, pusher tubes are removed one at a time by rotating guard disk E-13 of Fig. 16. E-12 is an aligning disk and E-9

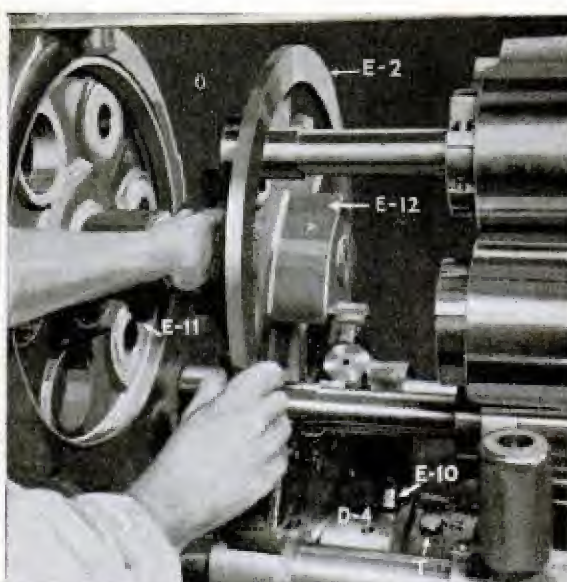
is a spool bushing which is used on the end of all pusher tubes.

To change collets, each spindle must be indexed to the 1st position. The finger holder is released with the hand chucking lever H in Fig. 18, and the nut collar C-12 is screwed off to pull the tube through the spindle nose far enough to remove the collet thereon and substitute one of required size. The next step consists of installing all spindle-speed and feed-change gears as specified in the instruction sheet. The cam T on the stock-feeding drum D-4 is set to regulate the advance of each bar at the 6th position. E-12 is the aligning disk and E-13 the guard disk also shown in Fig. 16. Fig. 19 shows how the stock-feeding slide is located on the high point of the cam T of Fig. 18. The high point of the cam is put in line with roller E-10 of Fig. 19. This is accomplished by loosening screw E-11 and pushing the aligning disk E-12 and the stock-feeding ring E-2 forward. Then the various side-slide and end-slide cams are adjusted according to instructions. The speed at which the cams revolve and their contour govern the timing and depth of cut for each position. Fig. 20 shows setting the cam on the end tool slide drum.

As previously stated and shown in Fig. 8, loading is done at the 6th position. This is where each bar is advanced by a pusher. The first side and end cuts therefore take place at this position and the second cuts are made at the 1st position, and so on. Once the cycle is in order and the machining is being started at the 6th position, a completed piece is cut off the bar at the 5th position although it was actually completed at the 4th position. Fifteen or twenty simultaneous operations often occur



(18) COLLET ADJUSTMENT MECHANISM



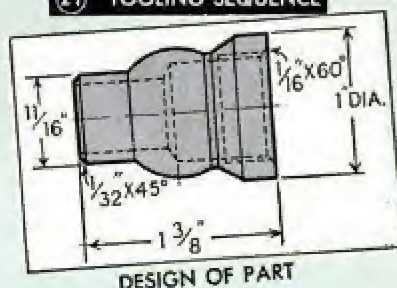
(19) LOCATING STOCK-FEEDING SLIDE



(20) ADJUSTING CAM ON END TOOL SLIDE

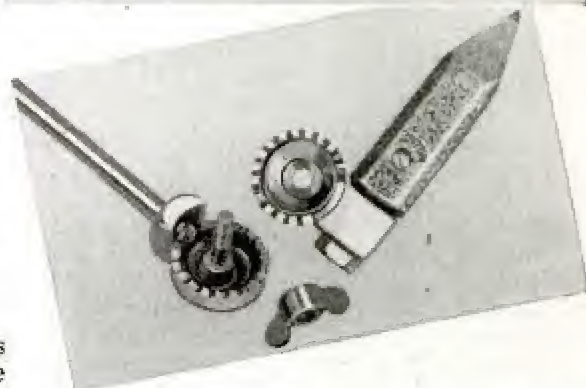
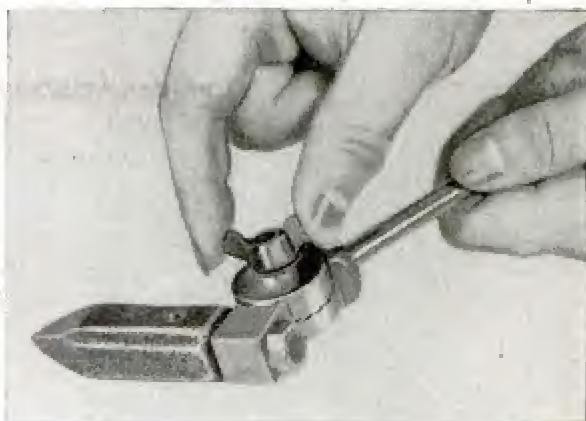
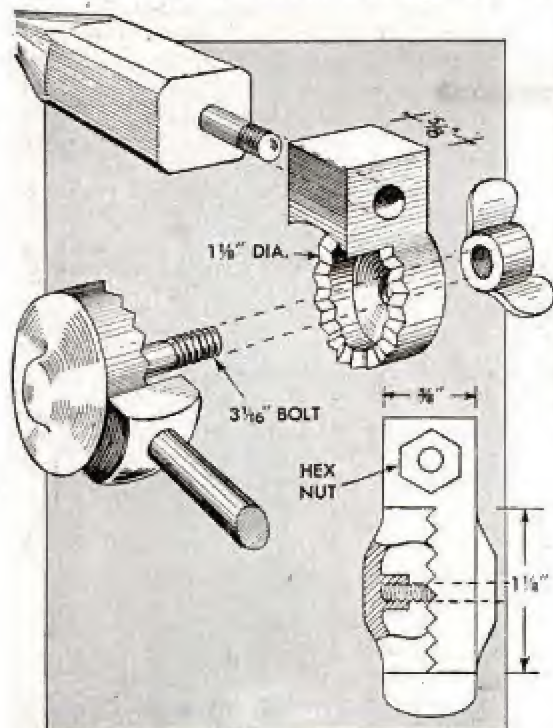
during the cycle which might consume but a few seconds. As a typical example, take the part shown in Fig. 21. This item required 45 pieces of tooling such as collets, pushers, spool bushings, cutting tools, rests and tool holders. It was produced at the rate of 336 pieces an hour. At the 6th position, the part is rough-formed at A and spot-drilled at B. At the 1st position it is finish-formed at E, faced at C and partly drilled at D; at the 2nd position it is drilled through at F. At the 3rd position, shaving tool G smooths the cuts A and E while a combination counterbore-reamer H goes to work. In the 4th position the part is being tapped (I) about $\frac{1}{4}$ in. deep and in the 5th position it is cut off (J). With screw-machine production, it is important that both the work and cutting tools be kept flooded with high quality coolants.

(21) TOOLING SEQUENCE



	TOOL REQUISITION
<p>6th POSITION (REAR)</p>	6-1" dia. round collets 6-1" dia. round pushers 6-1" dia. round spool bushings 1-D.D. cir. form tool holder 1-Circular forming tool 1-1" dia. drill 1-Drill bushing
<p>1st POSITION (FRONT)</p>	1-Dovetail form tool holder 1-Dovetail forming tool 1-47/64" drill 1-Drill bushing 1-Knee turner
<p>2nd POSITION (FRONT)</p>	1-High-speed drilling attach. 1-Drive unit 1-1/2" drill 1-Drill bushing
<p>3rd POSITION (FRONT)</p>	1-Shaving fixture 1-Shaving tool 1-Roll rest 1-Combined reamer and counterbore 1-Floating bushing
<p>4th POSITION (REAR)</p>	1-Universal threading attach. 1-Releasing type tap holder 1-13/16"-24 tap 1-Lead cam 1-Guard cam 1-Return cam 1-Bushing
<p>5th POSITION (REAR)</p>	1-Cutoff tool holder 1-Cutoff tool

Jointed Soldering Iron Handy in Tight Places



To solder those hard-to-reach places where space is limited, tinner's will save much time and effort by using an iron with an adjustable head like the one illustrated. The swivel joint from an old bridge lamp is just the thing for this purpose. Saw through the shaft of the iron and thread the head end to take a retaining nut. The other end of the shaft should be threaded to fit the swivel where it was screwed to

the lamp frame. If you can't get the serrated parts, you can use ordinary shafting and depend on friction between the contacting flat surfaces to hold the parts together firmly. If the flat surfaces are roughened with a file, they will grip better.

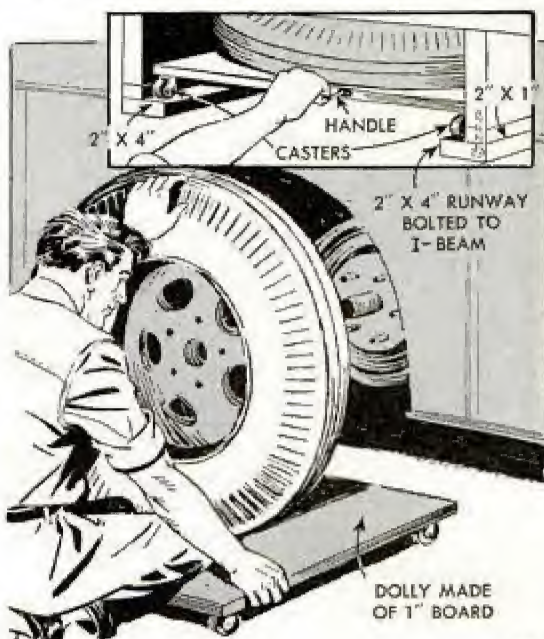
-F. T. Brown, Chicago.

Dolly Saves Heavy Lifting When Changing Truck Tires

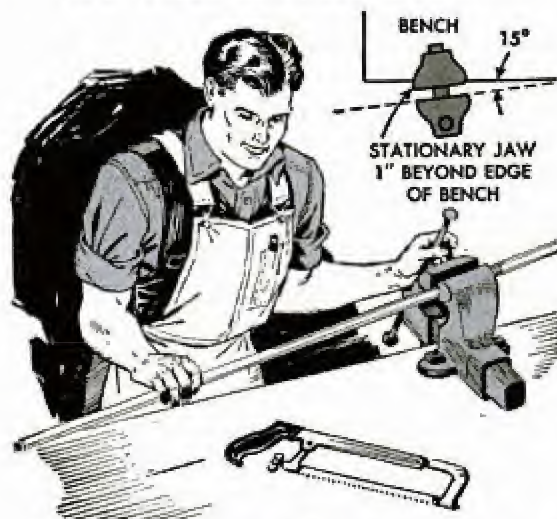
Noticing that mechanics in garages often used a dolly to aid in changing heavy truck tires, one driver adapted the idea to help when changing a tire on the road. The spare tire was carried on the dolly, which worked on a track between the body sills as indicated in the upper detail. Although not shown, two bolts through the track and dolly held the latter in place. With this arrangement, the spare tire is merely pulled out with the dolly, after which the latter is used as shown to remove the flat tire and put on the spare.

Clean Screen Stops Bearing Leak

Common cause of V-8 main bearing leaks is the breather-cap screen, which often plugs up with dirt, causing pressure in the crankcase that may make leakage in front or rear main bearings. To avoid this difficulty keep the screen well cleaned, and if it has rusted, replace it.



How to Mount Your Bench Vise To Make It More Useful



When you mount a bench vise, place it so that the stationary jaw extends 1 in. beyond the edges of the bench, and also mount it so that the jaws are at an angle of about 15 degrees to the bench edge. In this position, you can stand work on end on the floor and still grip it in the vise. Also, long work can be gripped in a horizontal position with one end resting on the bench. This keeps the long overhanging end of the work from dropping to the floor every time the vise is released to readjust the work.

—S. C. Moore, Niagara Falls, Ont., Can.

Melons Set on Dirt Mounds Have Uniform Color



One farmer avoids decay and uneven ripening of melons or squash by placing them on mounds of earth while they are still green. This exposes the greatest area of the melon to the sun and air, and leaves but a small

space in contact with the soil. Also, the mounded soil dries out quickly after a rain so that the melon is not resting on the wet ground which may cause it to rot.

Correct Firing Order of Motor Determined With Oil

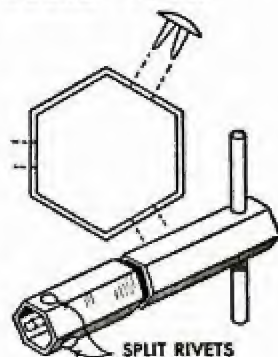
A few drops of oil in the spark-plug sockets, after loosening the plugs, makes it easy to determine the firing order of any motor. When the motor is cranked slowly,

the oil will bubble in the sockets as each piston comes up on the compression stroke, at the top of which the plug fires. This is much easier than taking off the valve cover, when no reference book is available, and is certainly much easier than a random trial-and-error method, considering there are many combinations for the firing order of an internal combustion motor.

—Marceille Conklin, Ojai, Calif.

Oversize Socket Wrench 'Padded' For Use on Small Work

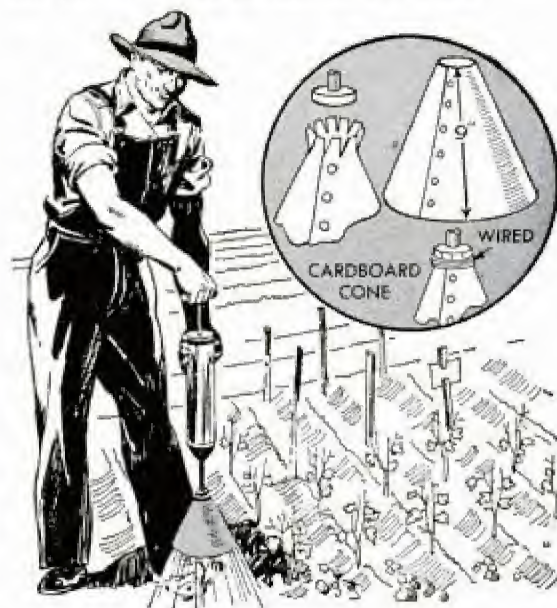
I recently had a set of spark plugs to install and the only wrench available was slightly large. To make the wrench fit the plugs, I drilled holes through the flat sides and put in split rivets and flattened them.



This made the wrench a little small, but a few strokes with a file reduced the rivets so it would fit. If the wrench is needed for larger plugs the rivets can be removed easily.—Hollis D. Hatch, Wollaston, Mass.

Plant Duster Fitted With Cone Assures Better Coverage

To assure better coverage of plants and to avoid waste of dusting materials, one farmer fitted a paper cone to the nozzle of his dusting gun as shown. The cone must be large enough to fit part way down over the plant so that the dust is confined and not permitted to spread in the wind.



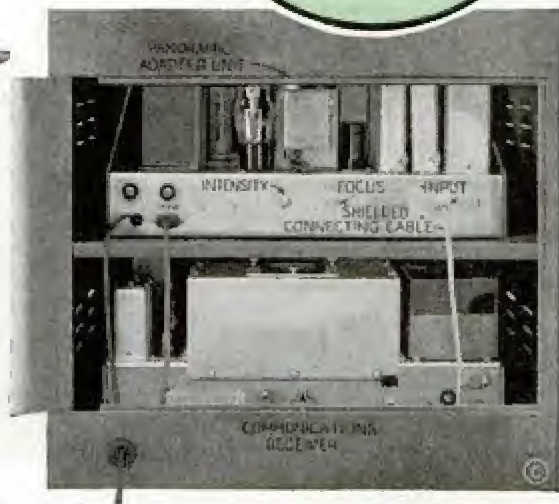
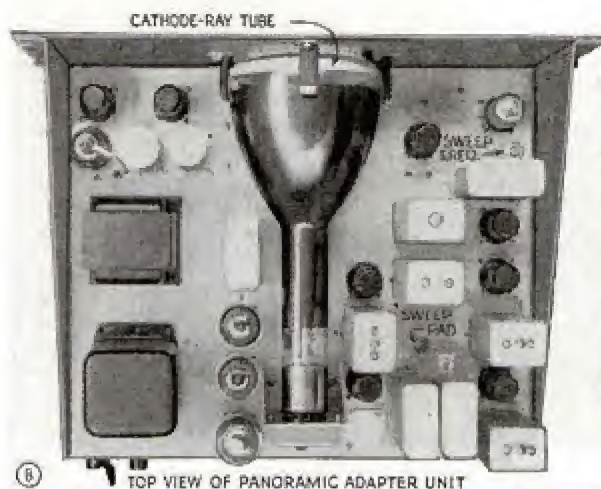
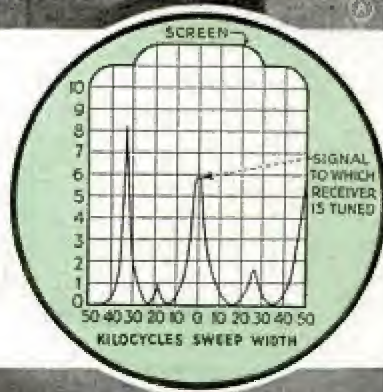


Panoramic Receiver the "Electronic Detective"

By Cyrus T. Read, W9AA

ONE of the many important wartime duties of the cathode-ray tube is the detection of illegal transmitters operated by enemy agents. Used in an adapter unit connected to a Hallicrafters type SX-28 communications receiver, this tube makes visible a 100-kilo-cycle section of the radio frequency spectrum and permits the operator of a monitoring station to observe simultaneously all transmissions in that portion of the wave band. Weak signals from illegal stations that could easily be missed in the noise and "static" of normal loudspeaker reception are plainly visible on the cathode ray tube screen.

Racked as shown in photo (A) the panoramic adapter unit (B) is mounted above the receiver; a small part of the output of the receiver's first detector is fed into the input of the adapter through a coupling resistor. Connections are quite simple, as shown in rear view photo (C). The signal to which the receiver is tuned appears as a glowing inverted "V" in the center of the cathode ray tube's screen. In addition, all other signals up to 50 kilocycles on either side appear as illustrated in the inset sketch of the tube screen. As the receiver is tuned, the signals move across the screen so that the station being received always appears in the center, or zero, position.



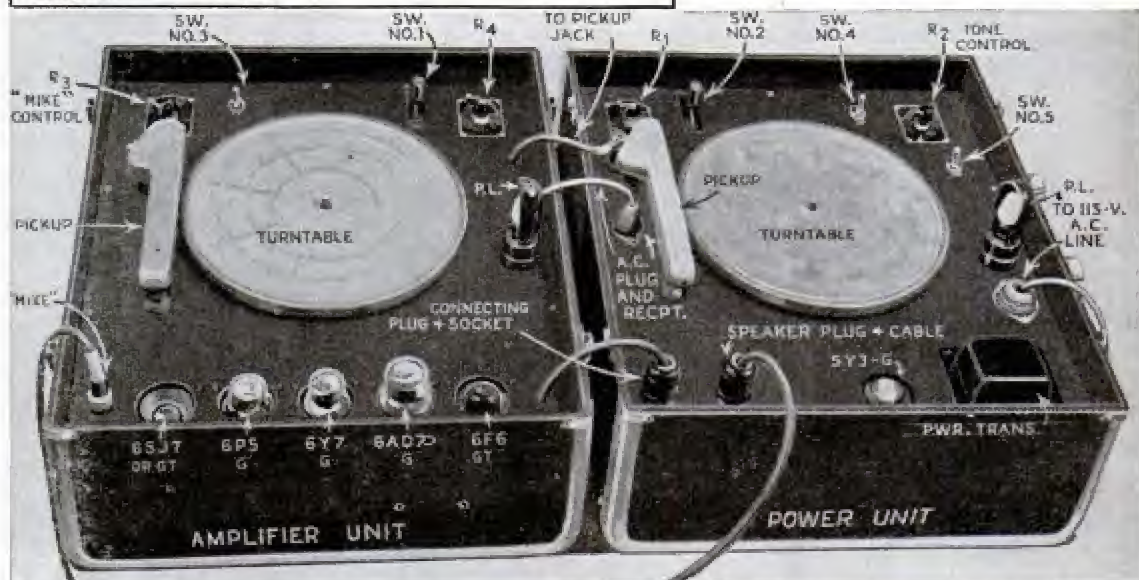
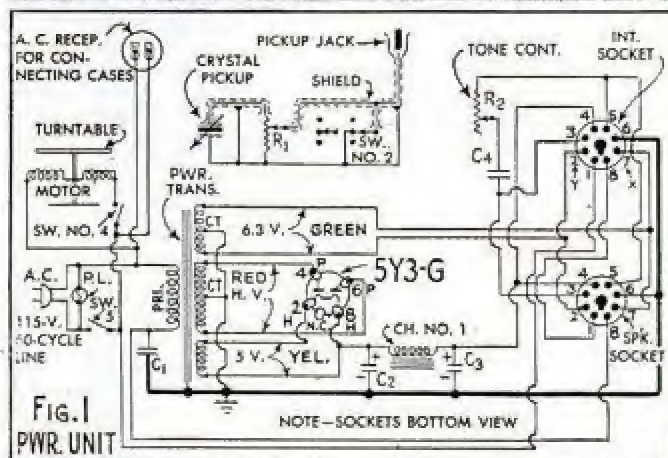
DUAL PHONO UNIT HAS

By Arthur I. Rattray—Part I



MOST home movie makers have at some time or other desired to have an appropriate musical background for their pictures, and also a means for describing the scenes being presented. The dual record player illustrated meets all of these requirements and includes electronic controls for fading the records and microphone in and out. Two-pole, 3-position switches are employed for dubbing in sound-effect records, and hooded pilot lights are provided.

In one split case there are two phono turntables with their respective pickups, a high-gain amplifier with push-pull audio; three channels for electronic mixing; two phono channels and one "mike" channel. Both sections of the case fold together into one compact unit; the P.M. speaker and its connecting cable fit into another portable case. The materials except the large case and a few accessories, such as the 35c "night lamps," came from a well stocked radio experimenter's junk box. The phono motors and turntables were salvaged from old record players. Each motor has its own switch (SW3 and SW4), and SW5 is the master switch. The "mike" channel has very high gain and its volume can be varied without dis-

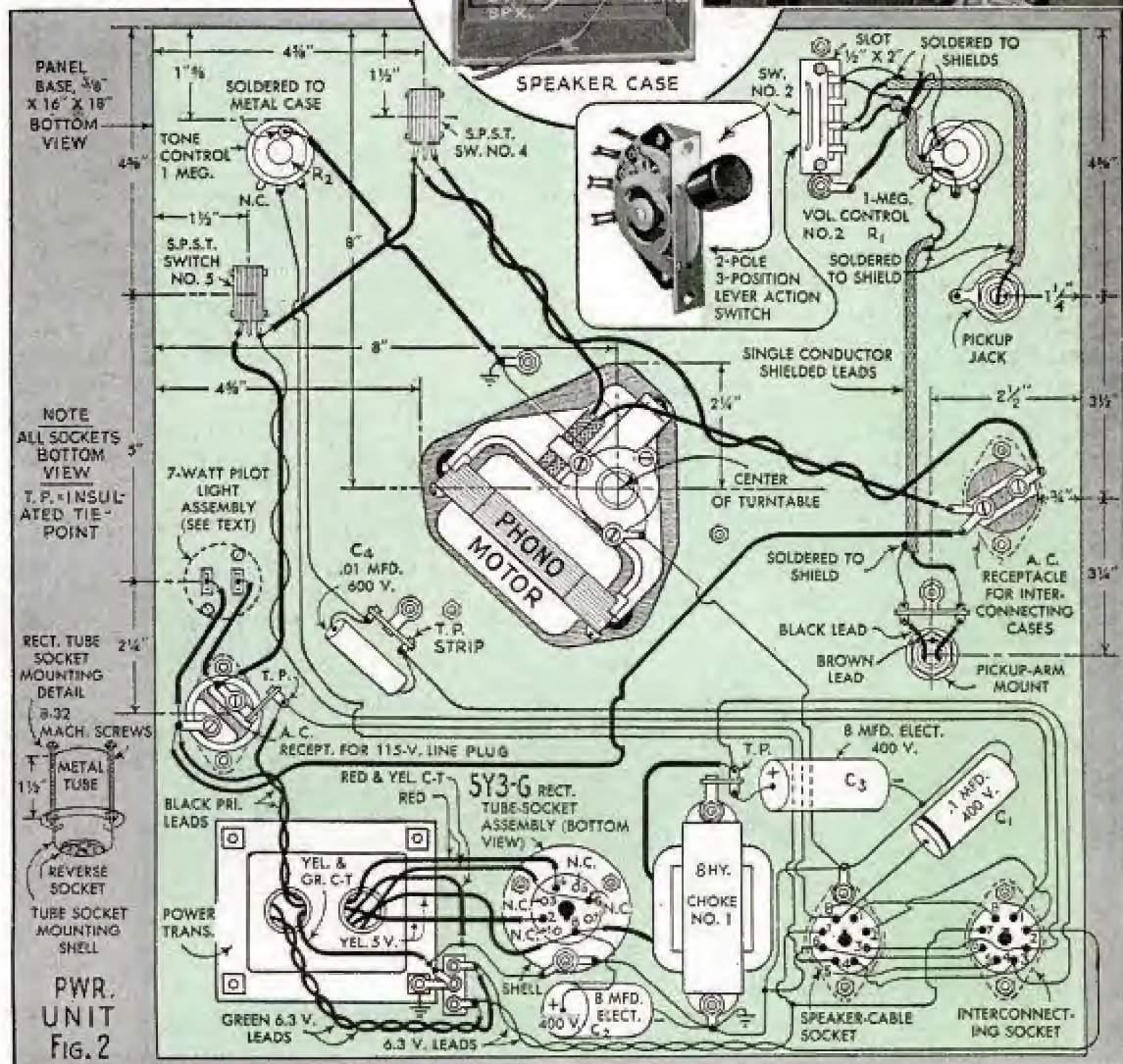


SELF-CONTAINED AMPLIFIER

turbing the volume of the phono channels.

Although not designed for radio beginners, there is nothing particularly difficult about the construction. The schematic circuit diagram for the power unit section appears in Fig. 1. Pictorially presented in the underside view Fig. 2, all wiring is clearly shown. The power transformer is a common broadcast receiver type; 600-volt center-tapped secondary at 120 ma.; 5-volts at 3 ma.; and 6.3 volts at 5 ma. Choke No. 1 is a common filter type (8 henries, 120 ma., 250 ohms.) Outside measurements of each case section are: 16½ in. wide, 18½ in. long and 6¾ in. deep. Wood cleats support the panels 1½ in. below tops.

(To be continued)



Helpful RADIO SUGGESTIONS

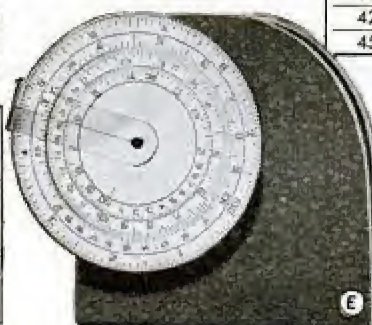
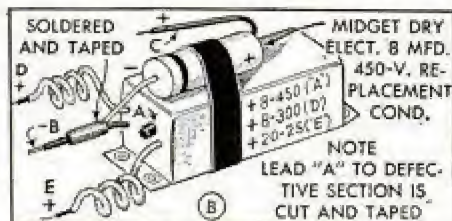


(A) Handy drill chart tells at a glance exactly which drill size to use for clearing certain sizes of machine screws used in radio repair work; also for correct size holes to permit tapping in steel or brass. Use next larger size drill for tapping Bakelite or similar composition materials. Drills kept in a numbered stand are always ready for use

DRILL CHART FOR RADIO USE			
Drill Number	Diameter Inches	Clears Screw	Correct for Tapping Steel or Brass
2	.221	12/24	—
10	.193	10/32	—
16	.177	—	12/24
18	.169	8/32	—
21	.159	—	10/32
25	.149	—	10/24
28	.140	6/32	—
29	.136	—	8/32
33	.113	4/36	—
35	.110	—	6/32
39	.100	3/48	—
42	.093	—	4/36
45	.082	—	3/48

(B) When only one section of a multi-section electrolytic condenser "burns out" do not discard the entire unit, simply replace the defective section with a compact single unit "Atom" type dry electrolytic condenser of the same capacity and voltage rating. Mount and connect as shown in sketch; new positive lead "C" replaces defective section "A"

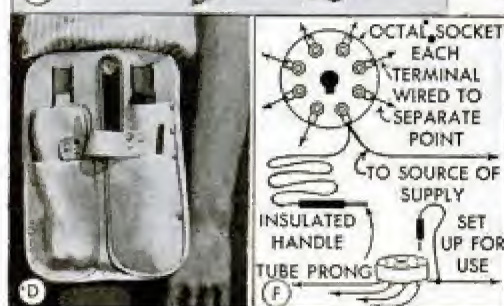
(C) Electric soldering iron has a machined well and groove which can be filled with solder thus freeing one hand to hold work



(G) Tab-type wire markers for identifying very fine wires or small diameter radio conductors; (H) Stainless steel tube clamps mount on chassis for locking radio tubes securely in mobile radio apparatus subject to extreme vibration stresses

(D) Leather tool holder for radio workers belt, has numerous pockets; (F) Seven-point switch made from an octal tube socket, may be used in crystal receivers or test sets to substitute for tap switches

(E) Vest-pocket slide rule for quickly solving problems in multiplication, division and proportion



Here's how your car

FEELS...



... after
MARFAK
chassis
lubrication!

You're in clover in more ways than one with a MARFAK chassis lubrication job. Your car loses that old lopy feeling, takes on velvety smoothness and new handling ease. And it's efficiently protected against wear by tough, long-lasting MARFAK that has been applied by *chart* not by chance. Every point of wear, every point of adjustment gets a going over . . . from control arms to rear shackles. Ask your Texaco Dealer to give your car that "MARFAK feeling" — now!

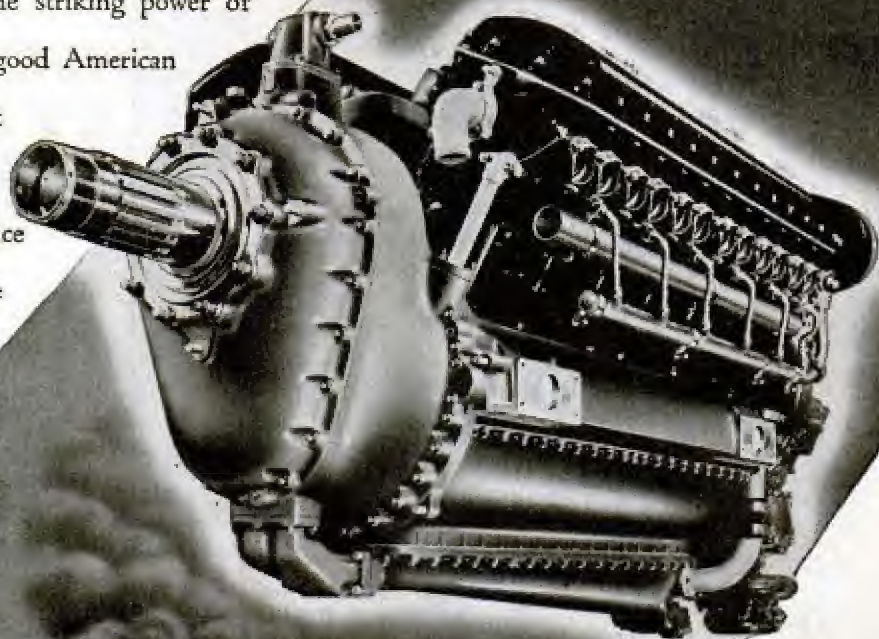
THE TEXAS COMPANY



TUNE IN the TEXACO STAR THEATRE every Sunday night. See your local newspaper for time and station.

STRIKING POWER

More than 50,000 Allison engines have been built for the use of Allied fighting pilots around the globe. ★ These skilled pilots using fighting planes powered by these engines have established a lopsided "box score" in our favor. ★ That is testimony to the striking power of good men armed with good American fighting equipment. ★ It is also an indication of aircraft engine performance you will be glad to have in the planes you use after final victory.



POWERED BY ALLISON

P-38—Lightning

P-39—Airacobra

P-40—Warhawk

A-36 and P-51—Mustang

The more-than-50,000 Allison engines built for the U. S. Army Air Forces power the above planes.

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF

Indianapolis, Indiana

Every Sunday Afternoon



**KEEP AMERICA STRONG
BUY MORE WAR BONDS**

GENERAL MOTORS SYMPHONY OF THE AIR — NBC Network



THIS AMAZING FLASHLIGHT BATTERY STAYS FRESH FOR YEARS

Power Is There - When You Need It!

Many flashlight batteries go dead just lying around in a flashlight. But not Ray-O-Vac LEAKPROOF Batteries! With LEAKPROOF'S patented sealed-in-steel construction, the power won't leak out—it's there when it's needed for years and years. And it protects your flashlight from corrosion damage.

**RAY-O-VAC LEAKPROOF BATTERIES ARE
NOW GOING 100% TO OUR ARMED FORCES**

FLASHLIGHTS



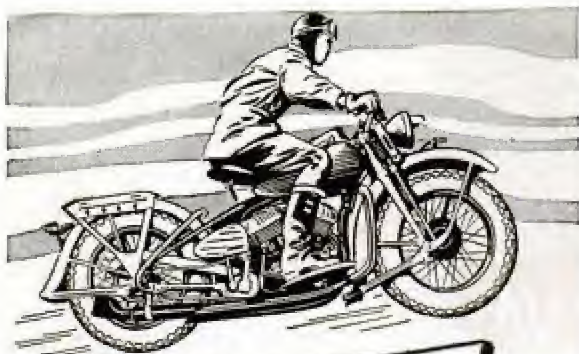
BATTERIES

BUY WAR BONDS



BUY WAR STAMPS

RAY-O-VAC COMPANY, MADISON 4, WISCONSIN
OTHER FACTORIES AT CLINTON, MASSACHUSETTS • LANCASTER, OHIO • SIOUX CITY, IOWA



"I REMAIN, AN OLD HARLEY-DAVIDSON BUG" - - - - -

IT'S the way F/O George B., ends his letter that explains how Harley-Davidsons and motorcycling get under a fellow's skin:

"Am an American in the Canadian Air Force — served over three years as a bomber pilot in the African, Sicilian and Italian shin-dig, and am now back in England as an instructor. Have ridden Harley-Davidsons more than twenty years — they are the best. I firmly believe motorcycling experience helps a lot toward being a good pilot. There's a marked similarity in the way both machines handle. I still yearn for my Harley-Davidson which used to keep me in good physical shape. I will have saved more than enough to buy a new Harley-Davidson after this fracas is over. I remain, an old Harley-Davidson bug."

That tells the story, men. Once a Harley-Davidson owner, you'll always want one. **BUY WAR BONDS NOW** — own a new, war-proved Harley-Davidson after Victory!

HARLEY-DAVIDSON MOTOR CO.
Department P, Milwaukee 1, Wisconsin



Write for free copy of
**ENTHUSIAST
MAGAZINE**
filled with motorcycle
pictures and stories.



**HARLEY-
DAVIDSON
MOTORCYCLES**

Torture Tests for Tin Fish

Continued from page 53

The water boils and bubbles, and puffs of smoke break the surface for the first few yards of the run.

Some torpedoes, improperly adjusted, are surface runners. If they get off the beam, they are dangerous. Only recently one smashed through the side of a range boat.

When the torpedoes are brought in by the retriever boats, they are hoisted back aboard the YTT and the exercise heads are taken off. Then the torpedo is sent to the huge overhaul shop, a windowless one-story structure. Several hundred torpedoes may be here at one time, some fresh from the factories being loaded with alcohol, water and compressed air preparatory to firing, some being examined and adjusted after firing, others awaiting shipment. One room in the shop is devoted to the gyroscope, the automatic helmsman which directs the torpedo.

So effectively do these steering devices work that few torpedoes are lost. Recently, however, a fishing vessel operating off Long Island not far from the testing range brought up a "tin fish" in its nets.

In this case, the special balancing mechanism in the practice head probably failed to work. These water-filled heads are so fitted that when the "tin fish" has finished its trial run, the water is discharged, lightening the nose of the torpedo so that it rises to the surface from 10,000 to 18,000 feet. The yellow noses are easily spotted.

Two types of torpedoes are tested at Montauk, one for use by surface vessels such as destroyers and the other for planes. Every "tin fish" sent to Montauk is fired at least once from the YTT. The long, destroyer-type cylinders are shot from tubes. The stubby aerial torpedoes are simply dropped into the water. In addition to the primary drop-test, one in every five of the aerial "fish" is also dropped from a plane, thus affording a double check on each lot.

If they don't stay on the line or travel at the right speed or remain at the right depth or go the correct distance, they are overhauled and tested again and again.

One celebrated "tin fish" was fired 23 times. On 22 tries something was wrong with it. It dived, it surfaced, it ran left, it ran right. Twenty-two times it was taken down and readjusted. On the 23rd test it ran "hot, straight and normal." With the men at the range breathing a collective sigh of relief, it was shipped out to the fleet. The good word came back later. The 24th time it hit the water it sank a Jap ship.



FLUID POWER ENGINEERING

by Parker

FLUID POWER. Confine fluid in a closed system, apply power at one end, and you deliver power instantly at the other end.

That is Fluid Power—based on hydraulics—the 1944 way to get work done. Any kind of work—hard or easy, brutal or delicate. Precisely-timed work or remote-controlled work.

You can step Fluid Power up or step it down—to lift a tank or wind a watch. You can make it fit the job. You can flow it around corners and into tight places. You can regulate it, by valves, within precise limits.

TRANSMITTING FLUID POWER. Fluid Power is transmitted through tubes; it needs no shafts, gears, pulleys or belts.

Tubes themselves are simple devices, easy to cut, bend, join or put in place.

But when a system of tubes is used to transmit Fluid Power, it calls for wrinkle-free bends, leak proof fittings, precise operating valves, flow without obstruction. It gets to be an engineering job.

FLUID POWER ENGINEERING. That's been Parker's business for twenty years—designing Fluid Power tubing systems, engineering them, building valves and fittings, and making fabricating tools. Often we do the fabricating, too.

War demands have made industry more and more aware of the great number of things Fluid Power can do. For us, that has been the basis of a healthy growth in experience and knowledge, and the variety of our products.

Today, you'll find Parker-engineered Fluid Power systems in refrigerators and bombers, in chemical plants and locomotives—everywhere in industry.

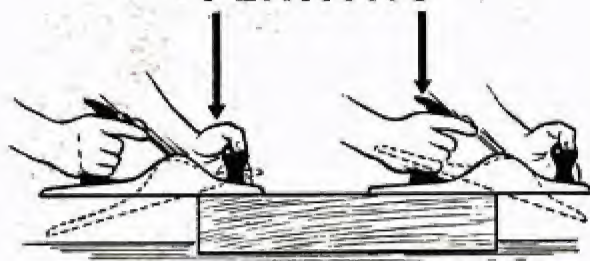
LOOKING AHEAD. With at least one eye on the future, wouldn't you like to talk this through now with a Parker engineer? No matter what you make, or what kind of machines you operate, you are likely to find some interesting possibilities in the Fluid Power idea.

An interesting booklet, giving you more facts about Fluid Power, will be sent on request. Address Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

THE
PARKER
APPLIANCE COMPANY
CLEVELAND • LOS ANGELES
FLUID POWER ENGINEERING

Tool Tips by STANLEY

HAND PLANING



To cut a long, straight edge or surface, push the plane *with the grain* – in the uphill direction of the fibres. *Keep the plane straight* by pressing down on the knob at beginning of stroke and on handle at end of stroke.

It is easier to plane a long straight edge with a long plane than a short one. A long plane bridges the low parts and does not cut them till the high spots are removed.

DOZENS OF PROVED METHODS ARE COVERED IN THE STANLEY TOOL GUIDE

More than 200 illustrations, with practical instructions covering the use of boring tools, dowsing jig, spoke shaves, scrapers, planes, marking gauge, and other commonly-used hand tools are included in this one book. Send for your copy today, 25c postpaid.



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for only 25¢*

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Enclosed find 25c. Please send me the Stanley Tool Guide, postpaid.

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Address.....

City..... State.....

Calling Signals for the Army

Continued from page 59

during the shock of combat after the tank has been driven for possibly thousands of miles. Frequencies for calling other tanks, the artillery, and command posts are selected by pushbuttons. All such sets are dust and water proof and are designed to operate under high temperature and high humidity conditions. Tankers and airmen wear throat microphones that pick up the vibration of their vocal cords while excluding exterior noise and reverberation. A two-ounce "lip mike" that straps under the nose and covers the mouth is also used.

Mobile, long-range radio stations provide the backbone of communication in the field. Contained in a 1½-ton truck that tows its own motor-generator on a trailer, such stations are operating today in the frigid north and in the equatorial jungles. Parked in a field, a flat top antenna is installed that gives such a station a range of up to 2,300 miles under good conditions.

Besides handling the Army's communication, the Signal Corps takes its picture. Combat photographers attached to the Signal Corps accompany troops into battle, carrying rifles in addition to still cameras or movie outfits. Some of their pictures have technical value, some are transmitted by radio back to the United States for use by magazines and newspapers. In their own domestic motion picture studios, the Signal Corps creates instructional films that are used in the training of new troops.

Another Signal Corps duty is technical operation of the Signal Photo Mail Service, the familiar air-borne V-mail, the volume of which is in the neighborhood of 23 million letters per month.

One job that Signal Corps men were handed and broke records in accomplishing was that of building a 2,060-mile phone line along the Alaska military highway. The line consists of two circuits that are expanded by carrier systems to provide seven talking channels and 14 teletypewriter channels. In building subsidiary lines in Alaska the communication men had to drop their reels of telephone wire by airplane onto a glacier, that being the only practical way to deliver it to the spot. In other places they found that their telephone poles wouldn't stay in the ground. The annual thaw pushed the poles up six inches to a foot. This was solved by setting three poles as a tripod.

That was just one more job for the Signal Corps men, the soldiers who live up to their motto that commands "Get the message through."

Young Horsepower for old cars



• Keep your horsepower *keen*, keep your motor *clean*—with Casite! A clean motor runs better, lasts longer and uses less gasoline. And millions of car owners have proved this under Casite's famous guarantee—

BETTER AND SMOOTHER PERFORMANCE OR DOUBLE YOUR MONEY BACK

You are invited to buy and test Casite on the unconditional promise that it must improve your performance noticeably or **DOUBLE YOUR MONEY BACK**.

It's as simple as that! So why not try Casite today? It is sold by service stations, garages and car dealers from coast to coast, and costs only 65¢ a pint.

THE CASITE CORPORATION, HASTINGS, MICH.

GUARANTEE

Add Casite to crankcase and run through carburetor according to instructions, then drive your car 100 miles or for 60 days, whichever is first. If not convinced that Casite gives you better and smoother performance, you get double your money back by filling out guarantee certificate and mailing it to The Casite Corporation, Hastings, Michigan. Maximum refund is \$1.30 per pint, twice the nationally advertised price of Casite.



CLEANS OUT MOTORS • KEEPS MOTORS CLEAN

DRAWFILING A GUN BARREL FOR DRAWING A SHARP BEAD



"Striking" a rifle barrel, to give it precision streamlining, aids the sharpshooter's eye. And the expert gunsmith knows just how to do it. He *drawfiles* the barrel—usually with a smooth-cut Mill file—to remove undulations left by the lathe-turning operation.

Only the most carefully designed, accurately cut and uniformly hardened files are good enough for such exacting work. That's the kind Nicholson manufacture is noted for. *The right file for the job and Twelve perfect files in every dozen* have become such Nicholson truisms that Nicholson and Black Diamond brands are widely the choice of mechanics who need the best in files for the work they do. **FREE BOOK—"File Philosophy"—48 pages.**

Nicholson File Co., 22 Acorn St., Providence 1, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

NICHOLSON
FILES FOR EVERY
PURPOSE

NICHOLSON
U.S.A.
MADE IN U.S.A.

Air Made to Order

Continued from page 75

planes. Temperatures within such chambers would become unbearable were it not for air-conditioning, and the efficiency of the tower man, and of the field, would be impaired.

In rooms where powder is being handled, in the loading of bombs or shells, exact control of the humidity is essential, for a variation might alter the burning rate of the powder when it is actually used. Consistent accuracy in battle demands that the powder all burn at the same rate, or shells will go wild, and bombs fail to explode at the proper time.

In the eerie navigation trainer used by the Army Air Forces, a simulated star-studded heavens gives the crewmen practice in reading the 12 navigational stars, which are in reality pinpoints of light spaced exactly as the stars would appear in the night sky. A variation of as little as two degrees in the chamber would give a false sextant reading, so Carrier air-conditioning units keep the temperature at an exact 72 degrees.

Air conditioning makes possible the phenomenal record of Yankee submarines. It is an essential tool of this metallurgical war, from the mines to the battlegrounds. One spectacular improvement affects the production of steel. It has long been recognized that particles of foreign matter in the blast air for steel-mill furnaces may affect the quality of the steel produced. With control of the blast air, all foreign matter may be removed, and uniformity of the steel assured.

These industrial installations of air-conditioning equipment are potent home-front weapons, but more than that, they point the way toward increased comfort and better health for all after the war. Already there are portable installations for any window that will clean and humidify the air, and warm it or cool it.

Similar installations to be attached to central heating units are also the subject of vast improvements, based on wartime experience. The old-fashioned idea of a steam-heated, dry-as-dust apartment, with its threat to health, should be replaced in postwar homes by air supplies tailored to the comfort of each member of the family.

It is safe to say that, with the inevitable boom in housing after the war, air-conditioning will be one of the most potent of all job-producing industries. Even the automobile industry might install air-conditioners in cars, at least for the luxury trade. It is feasible now.

WHY USE A NUT?

A nut draws things together and holds them tight. It permits taking apart and refastening.

If a nut loosens by itself, it fails in its job. A good nut must always hold.

That is the unusual virtue of the Elastic Stop Nut. Where an ordinary nut lets go, this one grips fast. It locks anywhere on the bolt. It can't wiggle or turn of its own accord—even under severe vibration.

But you can take it off and put it back on time and time again. It still locks. And it never mars the bolt.

The reason is the elastic collar in the top. When the nut is turned on, this collar squeezes between the bolt threads and hugs tight.

This provides security. That is why Elastic Stop Nuts are used by billions in America's airplanes. There are more of these nuts used than all other lock nuts combined.

After a while you'll see these nuts with the Esna red collar on the things you buy. And count on it—whether it's a new car, refrigerator, radio or what not, it will be stronger, safer, quieter and longer lasting because of Elastic Stop Nuts.



The Railway Express Agency uses a great many Elastic Stop Nuts on its fleet of 15,000 trucks. It uses them on many of the chassis and truck bodies as illustrated above, because once drawn up tight, they hold fast. No periodic taking up — no loose, squeaky or rattling trucks on the road, even in the face of day-in, day-out going and stopping on all kinds of roads.



ESNA

TRADE MARK OF

ELASTIC STOP NUT CORPORATION OF AMERICA

ELASTIC STOP NUTS

Lock fast to make things last

UNION, NEW JERSEY AND LINCOLN, NEBRASKA



SAVE THAT SAW!



A saw that's dull makes muscles ache!
Get it *fixed* for goodness sake!



Take it to your hardware store—
Saving tools helps win the war!



Where you see this window sign . . .
You'll get work that's extra fine!



Later on, you can *insist on*
A brand new saw made by DISSTON!



HENRY DISSTON & SONS, INC.
811 Tacony, Phila. 35, Pa., U.S.A.



GOOD ADVICE ON TOOLS *Free!*

The Disston Saw, Tool and File Manual tells how to use and care for tools. FREE at your Hardware Store, or write us for a copy.



Fighting Below the Water Line

Continued from page 79

water and oil rose to the men's shoulders before the pumps began to win. With the compartment still partly flooded, the men got the turbine back in operation.

Some of the water, however, was working into other punctured fuel tanks all the time the pumps were trying to get rid of it. This water was picked up by the fuel lines and carried to the boilers. The burners sputtered and went out. Five minutes later the big cruiser was dead in the water. She was an easy target for the Japs so one destroyer laid a smoke screen around her and the other three raced toward the enemy in a desperate torpedo attack, to gain a little time. A little time was all the cruiser's black gang needed. Three minutes after she had come to a stop they had cleaned the contaminated oil from the fuel lines and burners of one boiler and steam was being raised. A couple of minutes later she was under way again and back in the fight, firing broadsides. That action plus the oncoming destroyers was too much for the stronger Jap force and they turned and ran.

That's the story of one fight. There have been scores of instances in the last couple of years like it, in which the men in the bowels of our warships saved their ships and won our battles.

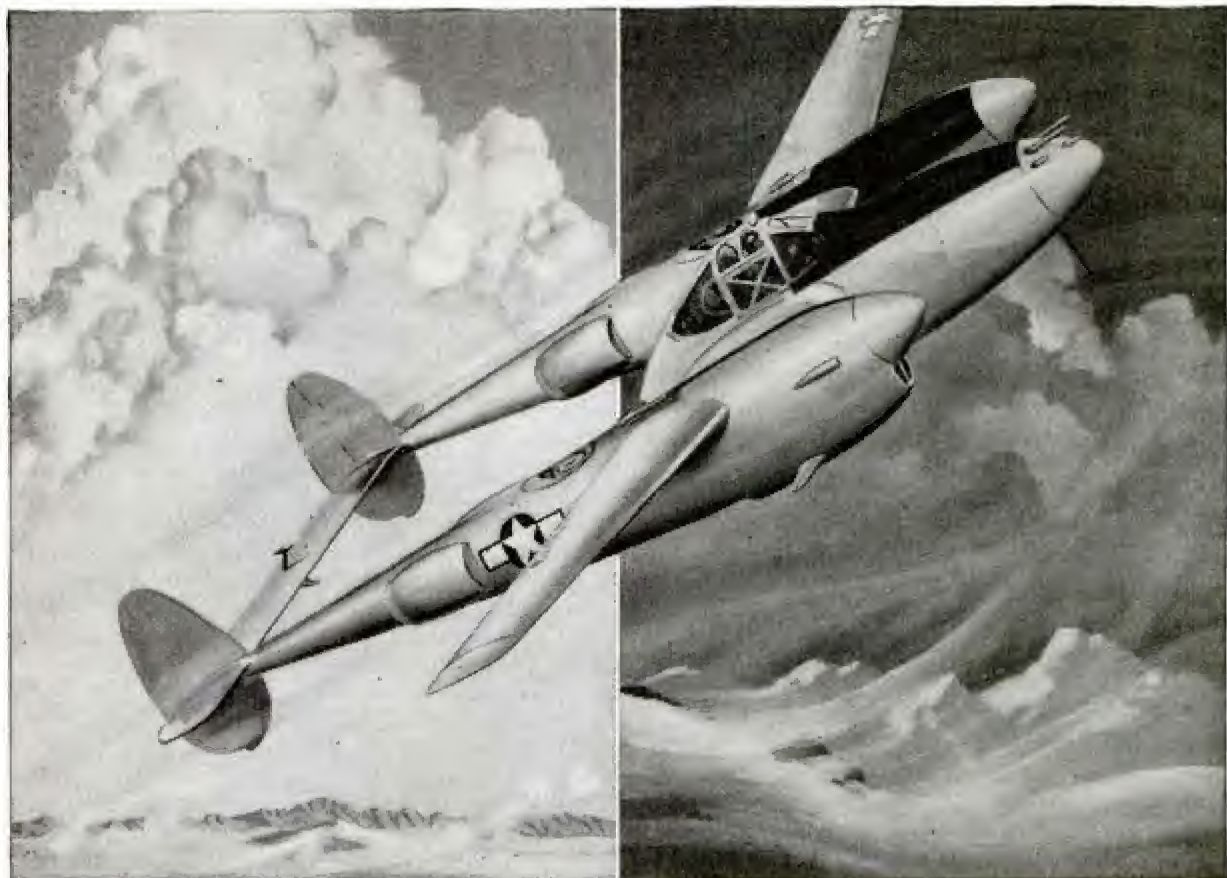
Our Animal Allies

Continued from page 37

flown into Burma in American-manned gliders to help operate supply lines. A total of 1,600 were used on the Burma front during the monsoon season in 1942 and there were only 12 casualties among them. One string of mules was credited with keeping a supply line open for several Allied battalions isolated when the heavy rains came. When the Americans began using mules on the yard-wide foot trails in the mountains of Italy, the Germans began a systematic slaughter of all the mules they could find. Despite much talk about snowmobiles, mountain-climbing jeeps and caterpillars, mules also have been relied upon to furnish supplies in the high country where the ski troops practice.

One of the few United States army mules who has been able to distinguish himself by an individual exploit is Mehitabel, who kicked in the head of a German soldier. Mehitabel, lost between the lines in North Africa and searching for a human friend, resented it when the German prodded her

Continued to page 156



FROM JUNGLE HEAT TO ARCTIC COLD

Finger-Tip Control for the P-38 Passes Toughest Endurance Test!

The Hycon "Stratopower" pump—standard equipment on the Lockheed P-38—has passed the grueling hydraulic test at the blistering heat of 160 degrees and at the bitter cold of 65 below zero. It stood up under 550 continuous hours of operation—the equivalent of about 200,000 non-stop flying miles—and still had the staying qualities to repeat the test.

A remarkable record, yes! But not surprising. For the "Stratopower" pump passes the acid test of active combat every day in every extreme of climate. Lockheed engineers, by installing aileron boosters actuated by this unique pump, have doubled this great plane's maneuverability and enabled it to fight better and higher—eight miles up in the stratosphere.

Until victory, our entire production of "Stratopower" pumps is reserved for fighting planes. And, to fill the tremendous demand, every available facility is being utilized at peak capacity.

For Industry's Postwar Uses

The compact high-pressure Hycon "Stratopower" pump, furnishing variable volume up to 3000 pounds per square inch—when no longer restricted by wartime needs—will do a great many hydraulic jobs better.

Out of the incredible demands of the war will come miracles of technological improvement to help rebuild a shattered world. More goods must be produced faster and cheaper. New machines will be created and old machines modernized. Hycon high-pressure hydraulic power units are ready with their contribution to this task.

If you have a problem of actuation in your postwar plan, or the modernization of your present equipment, Hycon will help to solve it. High-pressure (3000 pounds per square inch) pumps and valves, or assembled complete power units, are available for your requirements.

For Tomorrow Infinitely variable pressure controls at YOUR fingertips



HYCON * * *

REGISTERED TRADE MARK

Stratopower Pump

Patented — Manufactured only by The New York Air Brake Company

LET'S ALL BACK THE ATTACK — BUY MORE WAR BONDS

THE NEW YORK AIR BRAKE COMPANY

Hydraulic Division

420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

When Army tanks, jeeps, trucks, "Ducks," combat cars go into action, spark plugs must do their job—and keep doing it. To assure this unfailing performance, the Army takes great pains to check and clean its spark plugs,—millions of which are AC's.

As a "home-front soldier," you should take equal care of your spark plugs. All plugs should be cleaned and adjusted every 3,000 miles. That assures longer life, maintenance of engine power, better gas economy. Only when badly worn, should spark plugs be replaced. When you replace with new AC's, utmost reliability is certain.

Give your spark plugs this care and you will get the most from them—and also conserve materials, gasoline, and oil for our fighting men.



CLEAN PLUGS
SAVE UP TO
ONE GALLON
OF GASOLINE
IN TEN

AC
SPARK PLUGS

BUY THAT EXTRA WAR BOND THIS MONTH

irritably with his bayonet. Today Mehitabel is a government pensioner wearing a wound stripe.

For 2,000 years homing pigeons have been influencing the tide of battle and World War II is no exception. Among the pigeon heroes is "Yank," who brought back the news of the recapture of Gafsa by our troops in North Africa, making the 20 mile trip in one hour and 15 minutes. Then there is the "G. I. Joe" who flew 20 miles in 20 minutes to avert a possible bombing disaster in Italy. His message told headquarters that British troops had just entered Colvi Vecchia, the target of a flight of allied bombers about to take off.

"Lady Astor," a little pigeon WAC released from the front line in North Africa one day, was shot en route but managed to crash-land the next morning at the home loft, 70 miles away, still bearing the piece of paper strapped to her leg.

Today almost every combat branch uses pigeons, including the paratroops, tank crews, mechanized troops and infantry units, being transported in mobile trailer lofts, each accommodating 50 pigeons.

Lord Mountbatten's staff knew just what was happening on the beaches during the Commando raid at Dieppe because the pigeon couriers didn't fail. Officers aboard ships far out in the Mediterranean likewise were kept informed during the invasion of Africa. In both instances it would have been easy for the enemy to pick up radio broadcasts.

Signal Corps pigeons have tremendous feats to their credit. One was found capable of covering 500 miles in a day; another made a 2,100-mile flight through stormy weather across most of the United States. A new trick was added to pigeons' accomplishments in this war: they learned how to take off from airplanes flying between 300 and 400 miles per hour. Some of them instinctively performed a "dead drop" until they were clear of the ship, while others needed paper bags to cloak their wings until they were out of harm's way.

The services of the lumbering elephant and the homely camel are more specialized but equally indispensable. In 1941 the Indian Army elephant was drafted to replace the railroad from Rangoon to the Burma Road and keep open the life line to China. Today elephants are the light cranes, bulldozers, and mobile winches of the troops who face the Japanese on the India-Burma frontier. Laboring with the engineers, these animated mountains drive piles by stomping on them and haul heavy loads of timber through almost impassable jungles.

Continued to page 158

SCREWBALL IDEAS ON BATTERY CARE

#5



Marmaduke Daffy thinks he's charging his battery by driving down to the corner store each evening. Fact is, his starter and lights use up more "juice" on these short trips than his generator can replace. Better walk, Marmaduke. You're wasting gas and tires.

...THE WISE WAY IS PERIODIC RECHARGES!

RESTRICTED driving is bad news for batteries. Many cars aren't being driven enough to keep the battery properly charged. But you needn't let your battery weaken and "die".

Take it to your Exide Dealer for periodic recharges. That way, you can avoid starting trouble and postpone the day when you'll need a new battery. When you *must* buy, get a dependable, long-lasting Exide. Buy to Last—Save to Win.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

EXIDES ARE USED IN MORE THAN 100 APPLICATIONS BY OUR ARMED FORCES



- 1 Don't buy *anything* you can do without.
 - 2 If you **MUST** buy, insist on dependable, long-lasting merchandise.
 - 3 Take care of the things you have. Make them *last*!
- These conservation rules save materials for war production, help curb inflation, give you more money to invest in War Bonds.





*"Mighty" IS
THE WORD FOR
"Dyno-Mite"*

Here are little giants of the tool world — "Dyno-Mite" . . . world's smallest (users call them "finest") production tools. Perfectly balanced for easy handling, the streamlined drill packs surprising power. Weighing only 2½ pounds it is easily handled by women, yet it will operate in steel at speeds to tax the staying power of any operator.

And "Dyno-Mite" electric screw drivers and nut runners (illustrated), weighing only 3½ pounds, give greater load capacity and high efficiency with almost a total absence of vibration. The new "Adjustomatic" Selective Torque Clutch allows for instant adjustment from the outside of the tool and transmits power with velvet smoothness. Write for further details.



The pack camel, despite his halitosis and yellow teeth, is much in demand when it comes to hauling material to build desert airfields or conserving precious gasoline and tires. He has plodded patiently for the Allies in North Africa, Burma, India, China and southern Russia. Camels traverse the deep sand where ambulances and even mules founder.

Animals also serve the war effort as mascots. Warriors make pets of anything that walks, crawls, or wiggles, and this war has produced some unusual ones. Perhaps the most famous is Siwash, a duck who landed on Tarawa with a marine artillery unit and proceeded to rout a Jap rooster and pig. Eta, a monkey, was one of the most intelligent. Adopted by the 9th Air Force in the Middle East, Eta learned to pull the handle marked "salvo" on B-24 bombers.

Gateway to War

Continued from page 31

voirs for the runoff of cargo and comprise a final control by which a deluge of cargo or a scarcity of it at the port itself can be avoided. A holding and reconsignment point contains some three million square feet of warehouse and open storage space, up to 30 miles of trackage, and requires a staff of 1,000 employees.

At the port itself, ships are loaded in one of three ways depending on their destinations. Combat loading, for a ship that is to carry troops and equipment directly to a scene of action, means that the first pieces of equipment that will leave the ship are loaded last, on top, where they will be instantly available. Combat loading permits the troops to go ashore fighting.

Another arrangement is convoy loading. In this type of loading a full cargo is put into the ship with certain priority items on top. Organizational loading, the third method, is the same as ordinary commercial loading in which a ship is loaded to make best use of its cargo spaces.

Upon departure from port a schedule is laid out so that if any particular ship is lost at sea, its cargo can be duplicated without delay and loaded on another vessel.

The other function of a port of embarkation is the orderly movement of troops from their training camps to the ships. For this purpose huge camps known as staging areas have been established close to the ports. Here the combat units are made up at full strength, final physical examinations are conducted, training deficiencies are corrected and rehearsals of the type of fighting that they will encounter in their

Continued to page 160



**FREE
AIR HORSEPOWER**

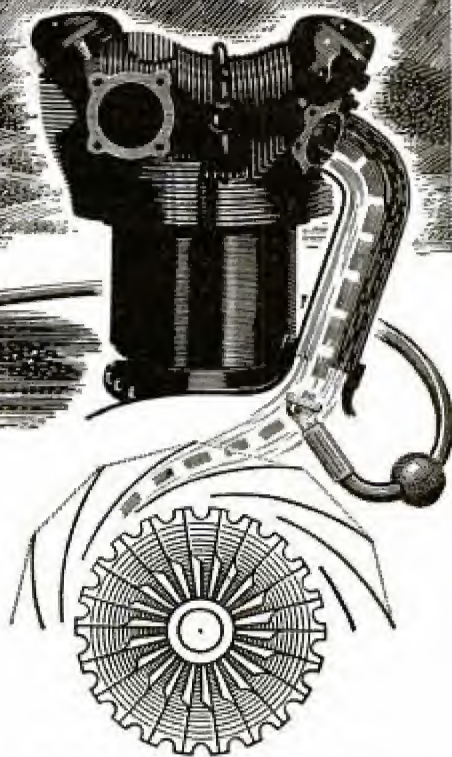


An aircraft engine supercharger is not a mysterious device; it is simply an air pump. By compressing more air into a cylinder, more fuel may be burned during each power stroke—which in turn means greater output. At sea level or altitude, whether turbo or gear driven, a supercharger's sole purpose is to increase engine horsepower.

Although it takes power to pump air with a supercharger, the result is a dividend of free horsepower far exceeding the investment. Flight at high altitude is impossible unless the rarefied air is first compressed, while in a Cyclone 9 at take-off, 100 HP spent to drive the supercharger rewards the engine with 500 additional horsepower at the crankshaft.

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LET'S ALL BACK THE ATTACK—BUY WAR BONDS

theater of the war are held. Shortages in equipment and supplies are made up. When a soldier reaches a staging area he virtually becomes a military secret. It is his last stop ashore before he sails.

Some time ago Japan complained bitterly over the radio about the seemingly endless flow of men and equipment that America was dispatching across the Pacific, north, west, and south. That was before the Pacific push really got started!

How the Invasion Was Planned

Continued from page 7


fact that daytime flying was too unhealthy for the enemy over England. One Yank protested that if we didn't stop piling up equipment, the island would surely tip.

One of the most effective new weapons in the invasion was a 50-pound rocket projectile that can be fired from ground positions, from barges, or airplanes, and can be loaded with explosives or chemicals for laying smoke.

The supply line extended back across convoy lanes, through U. S. embarkation ports, to depots in this country with 245,000,000 square feet of storage space. The process of moving supplies to England was gauged by the general timetable, radioed requisitions from supply officers in England, and the availability of ships. In one month, about 1,500,000 ship tons of cargo were shipped from New York alone.

When the convoys left U. S. ports, supply officers notified British ports of the contents, not only of the ships but of certain holds in the ships. In this way, supply officers in England earmarked items for the various depots so the goods could keep moving. Some of the high-priority cargo was moved by air as D-Day approached. Our commanding officers insisted on "amphibious packing" of goods so that they would remain intact after a dunking.

Continued to page 162



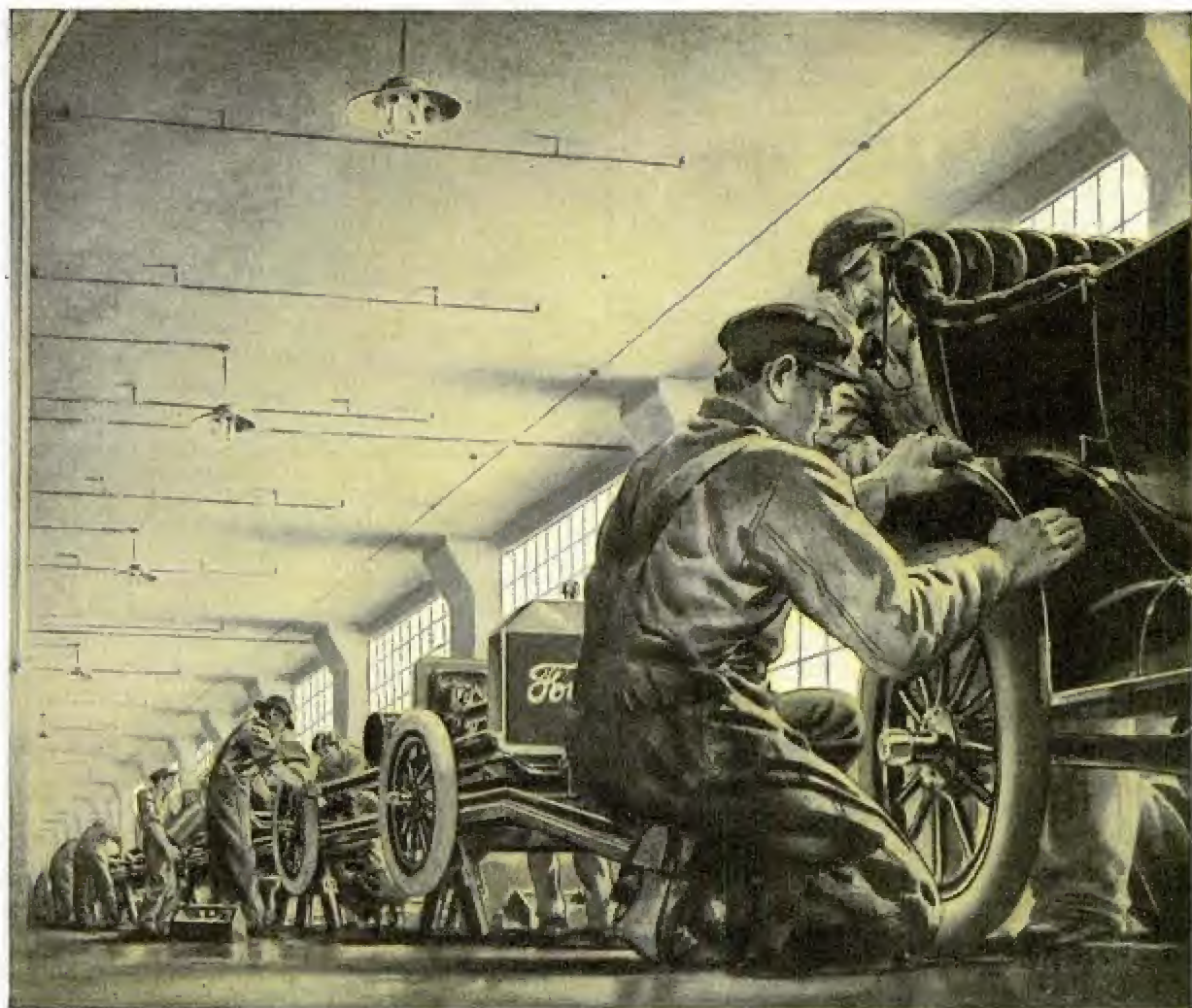
Model Builders Attention!

	V	V-2	V-3
Hex	1/2"	3/8"	3/16"
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Thread Length	7/32	7/32	5/32
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EARLY in 1913, Henry Ford had his technicians try a new production idea which had come to him as he inspected a watch factory. Instead of having a single group of men make the entire assembly on each flywheel magneto, the unit was moved from one worker to another. The result was a 50% saving in time!

"Why not test this idea on the whole chassis?" Mr. Ford next suggested. So now, along elevated greased rails, each chassis was being pushed by hand as workers added the various parts in sequence. *There and then, the assembly line was born!*

A chain-driven line was soon operating. And the 14 hours once required for a chassis assembly were cut to 1 hour, 33 minutes.

Before 1913 ended, over 100,000 Ford cars had been built, breaking all records for the industry.

This achievement meant more than a saving in time, more than creating new methods for all industry. To Mr. Ford and his associates, this was another step to make life easier for millions.

From the first, the assembly line technique of production eased working conditions. Along with other modern advances, it helped to increase the life span of work-

ers. At Ford, it soon made possible the 8-hour day. And with unskilled labor in many places earning as little as \$1 a day, Ford basic pay was raised to \$5.

The assembly line also brought price reductions on Ford cars, placing them within reach of more people. Sharing production savings with the public is fundamental with Ford.

Today, in the creation of equipment vital to victory, Ford men continue their search for better ways of doing things. What they are learning is bound to be reflected in the improved Ford transportation of tomorrow.

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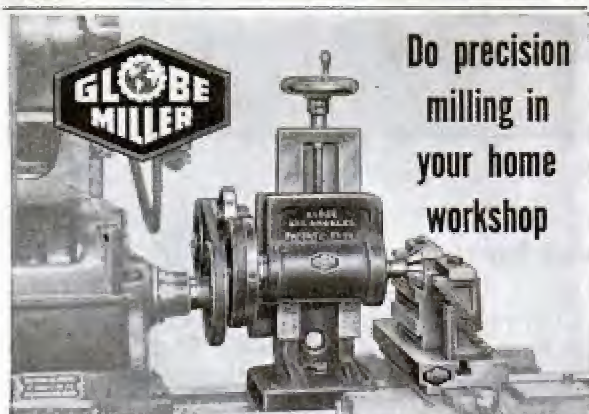


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While the Army was piling up supplies, transporting and training a huge invasion force, the Navy was constructing amphibious bases along the British coast. Navy and Army units practiced the loading and unloading of combat teams and equipment from dozens of types of landing craft.

All the time preparations moved ahead on a grand scale, Allied Supreme Headquarters maintained the strictest secrecy as to when and where the invasion army would strike. There were map rooms where even generals had to show special passes.

Although the Germans could not guess the place, they probably figured they could accurately set the time of day in accordance with the tides. Here they were fooled, for our invasion planners set the time four hours before high tide. Thus, most of the enemy shore batteries that had not been knocked out by our aircraft were caught napping. This plan was carried out even though General Eisenhower had to postpone the hour of attack 24 hours awaiting favorable weather.

As D-Day neared, the troops were briefed for their exact mission and reshuffled from battalions and companies into "craft loads," ready to move at a moment's notice. After briefing, the invasion camps were "sealed" and the men were forbidden communication with unbriefed troops or civilians. These final security measures prevented any leaks as to the hour and place of attack after briefing thousands of men.

When H-Hour came and the Navy and air crews moved the Allied forces across the channel, it was the culmination of the most minutely planned combined operation on record. The invasion forces were composed of inter-dependent units, a weak link in any one of which would have meant disaster. In the master plan, the air forces, ground troops, airborne divisions, and naval units were welded together to form the most powerful force ever hurled against an enemy shore.

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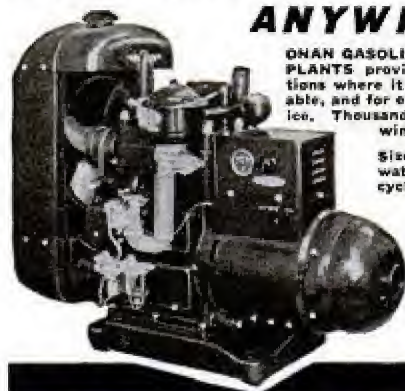
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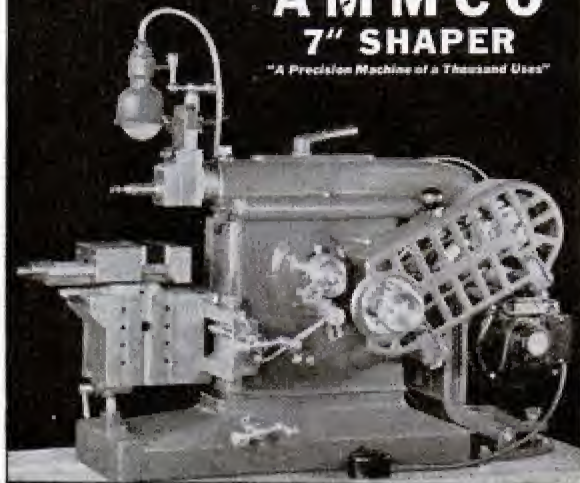
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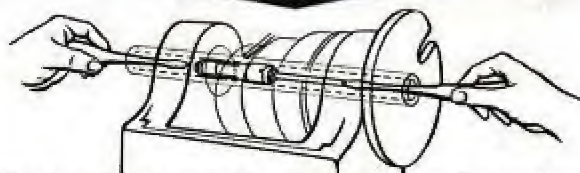
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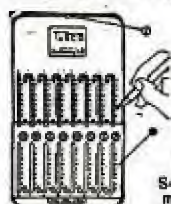
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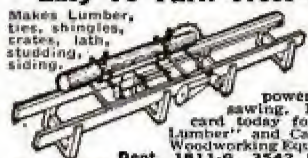
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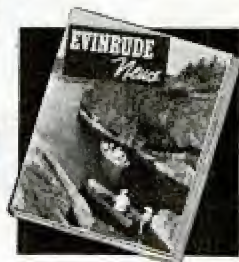
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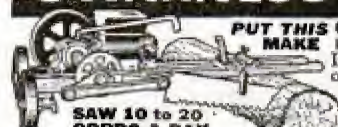
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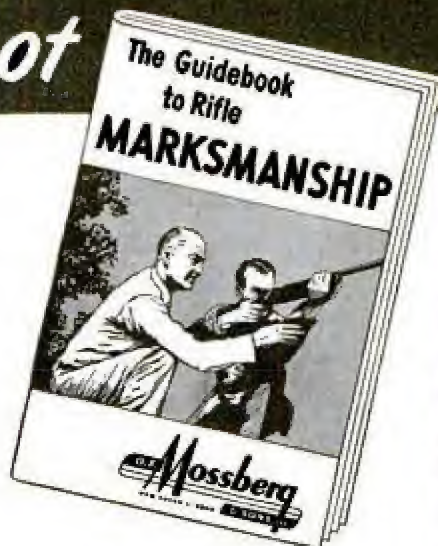
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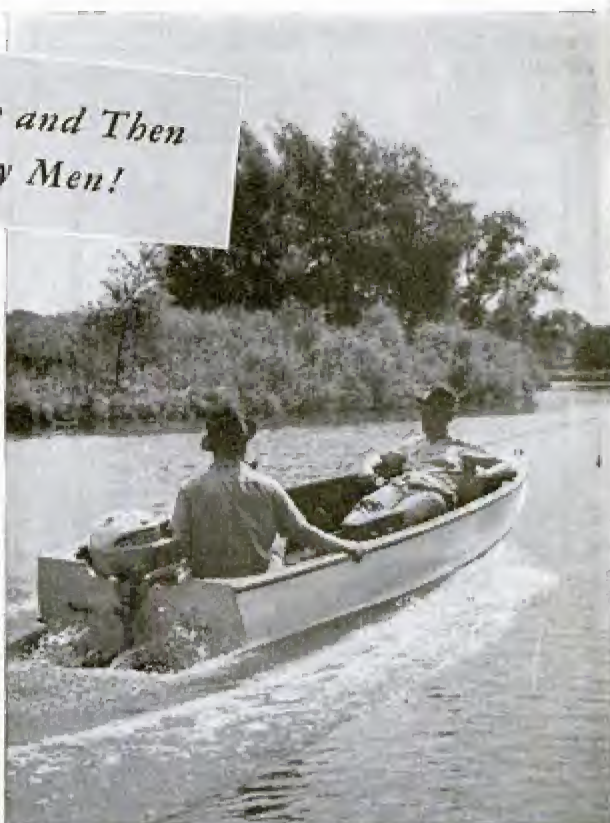
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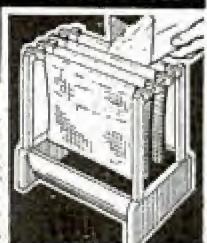
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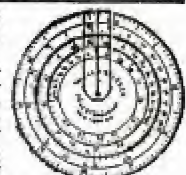
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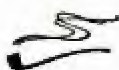
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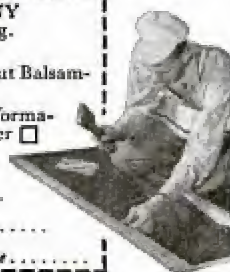
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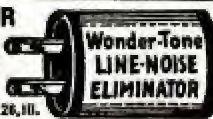
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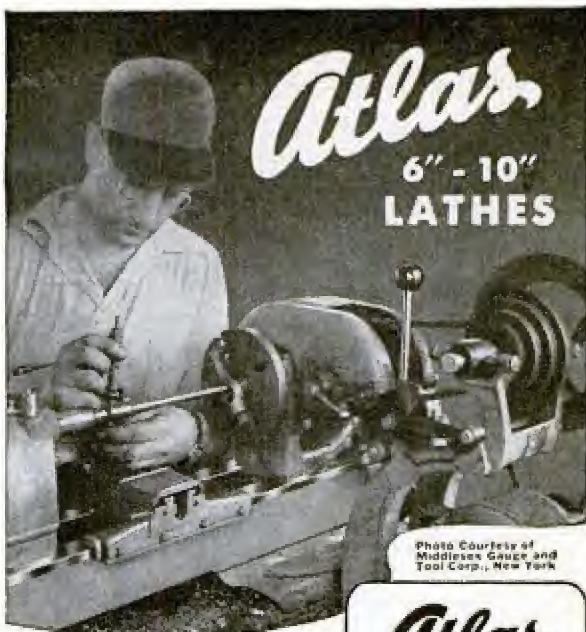


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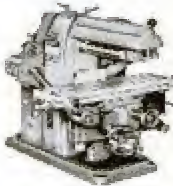
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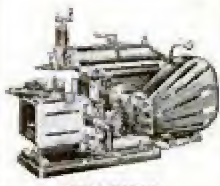
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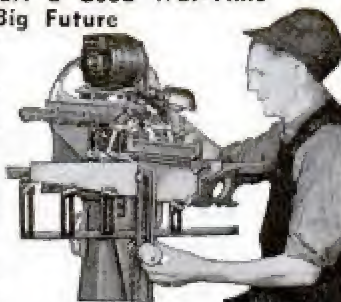
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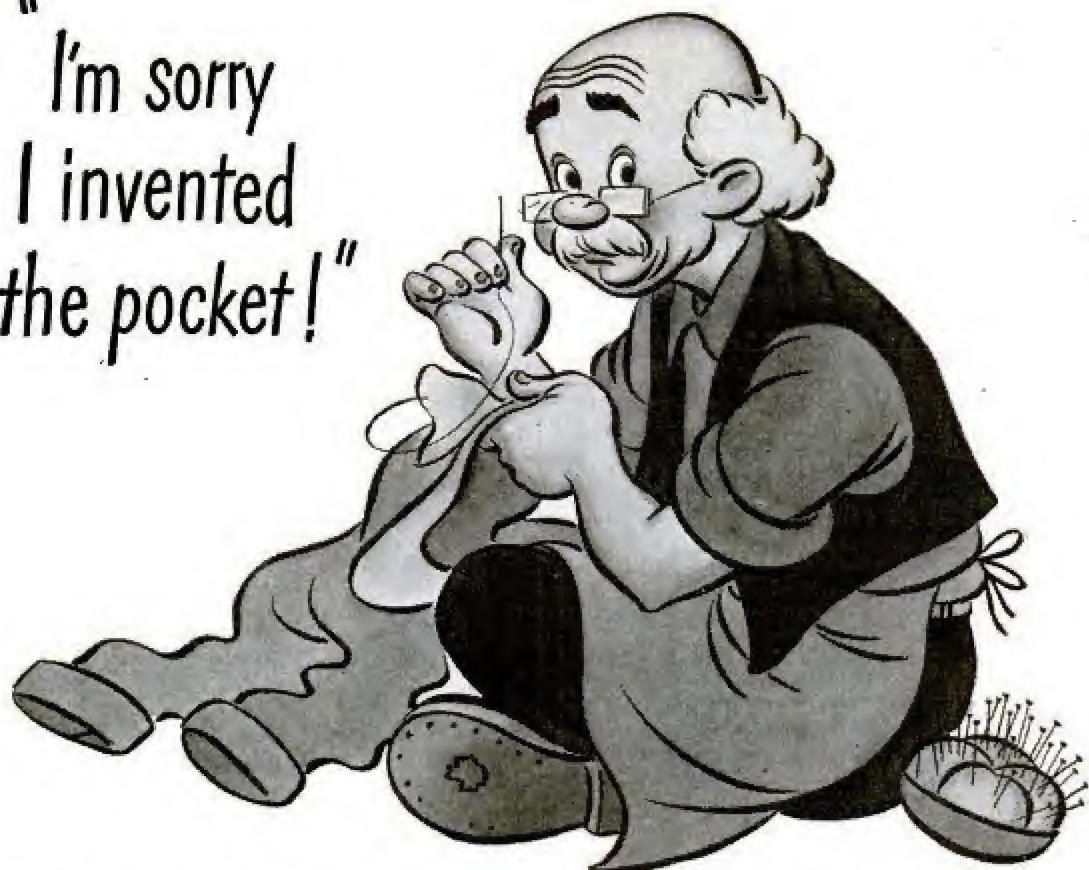
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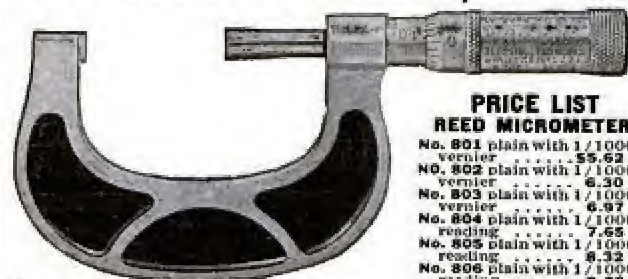


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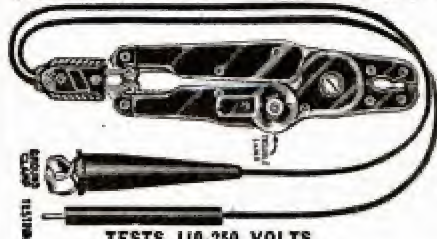
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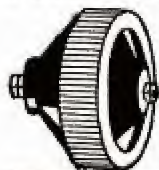


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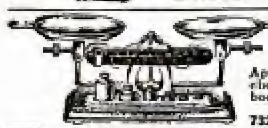
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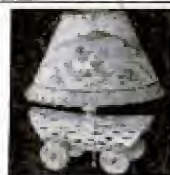
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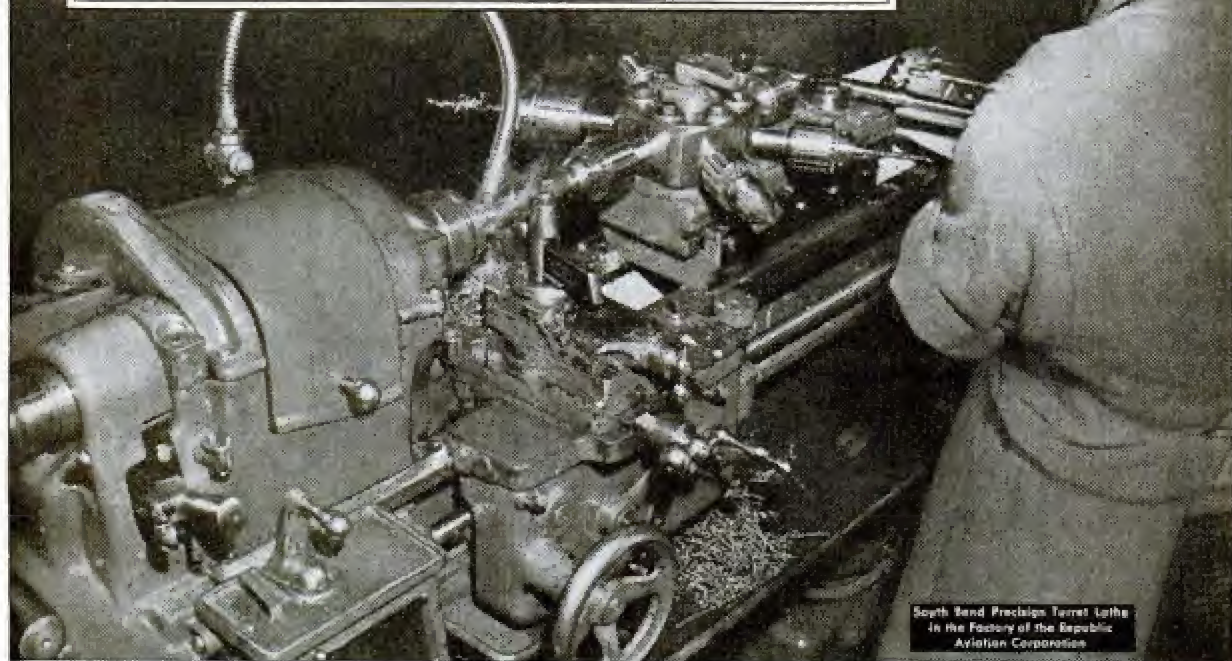
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